

SWEDISH WORK ENVIRONMENT POLICY

AN ECONOMIC ANALYSIS

Carl Hampus Lyttkens

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Abstract This is a study of the incentives generated by several work environment policy measures. The work environment is seen as one aspect of the multidimensional employment contract. The policy measures under consideration consequently change the composition of this contract. The policy measures are: the Work Injury Insurance and the Health Insurance, work environment regulations (the Work Environment Act), investment subsidies, and public support of work environment research and dissemination of information. The analysis is restricted to the physical shaping of places of work. This includes both positively and negatively valued work environment characteristics. The study focuses on decisions on the work environment, the situation of the individual employee, and the general state of the work environment in Sweden. This analysis highlights the importance of a comprehensive approach to the work environment area, for example in order to assess or evaluate the effects of public policy. The existence of the Social Insurance system decreases the amount spent by companies to prevent occupational injuries and reduce sickness absenteeism. Resources will shift to activities where injuries and absenteeism are more common. It is likely that large groups are overinsured. The effects of work environment regulations are shown to be difficult to assess, as compliance will not be complete and because of the nature of enforcement. To the extent that regulations compel companies to raise the quality of the work environment, this will be to the advantage of employees. The effects of the Social Insurance system on resource allocation will be counteracted. The subsidies to work environment investments have had ambiguous effects on the amount of such investments. When account is taken of the incentives generated by other work environment policy, one finds that research and dissemination of information in the work environment area may need some specific support, which is provided in the Swedish policy. In this study, it is also emphasized that other measures than "work environment policy" (in particular the tax system) have a considerable impact on the shaping of places of work. Finally, some suggestions are made in the area of policy evaluation.	
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Lund Economic Studies number 37

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CONTENTS

1. The first part of the report - Introduction and Summary	1
2. The second part of the report - The first investigation - the	2
Investment in the area of the	2
3. The third part of the report - The second investigation	3
Investment in the area of the	3
4. The fourth part of the report - The third investigation	4
Investment in the area of the	4
5. The fifth part of the report - The fourth investigation	5
Investment in the area of the	5
6. The sixth part of the report - The fifth investigation	6
Investment in the area of the	6
7. The seventh part of the report - The sixth investigation	7
Investment in the area of the	7
8. The eighth part of the report - The seventh investigation	8
Investment in the area of the	8
9. The ninth part of the report - The eighth investigation	9
Investment in the area of the	9
10. The tenth part of the report - The ninth investigation	10
Investment in the area of the	10
11. The eleventh part of the report - The tenth investigation	11
Investment in the area of the	11
12. The twelfth part of the report - The eleventh investigation	12
Investment in the area of the	12
13. The thirteenth part of the report - The twelfth investigation	13
Investment in the area of the	13
14. The fourteenth part of the report - The thirteenth investigation	14
Investment in the area of the	14
15. The fifteenth part of the report - The fourteenth investigation	15
Investment in the area of the	15
16. The sixteenth part of the report - The fifteenth investigation	16
Investment in the area of the	16
17. The seventeenth part of the report - The sixteenth investigation	17
Investment in the area of the	17
18. The eighteenth part of the report - The seventeenth investigation	18
Investment in the area of the	18
19. The nineteenth part of the report - The eighteenth investigation	19
Investment in the area of the	19
20. The twentieth part of the report - The nineteenth investigation	20
Investment in the area of the	20
21. The twenty-first part of the report - The twentieth investigation	21
Investment in the area of the	21
22. The twenty-second part of the report - The twenty-first investigation	22
Investment in the area of the	22
23. The twenty-third part of the report - The twenty-second investigation	23
Investment in the area of the	23
24. The twenty-fourth part of the report - The twenty-third investigation	24
Investment in the area of the	24
25. The twenty-fifth part of the report - The twenty-fourth investigation	25
Investment in the area of the	25
26. The twenty-sixth part of the report - The twenty-fifth investigation	26
Investment in the area of the	26
27. The twenty-seventh part of the report - The twenty-sixth investigation	27
Investment in the area of the	27
28. The twenty-eighth part of the report - The twenty-seventh investigation	28
Investment in the area of the	28
29. The twenty-ninth part of the report - The twenty-eighth investigation	29
Investment in the area of the	29
30. The thirtieth part of the report - The twenty-ninth investigation	30
Investment in the area of the	30
31. The thirty-first part of the report - The thirtieth investigation	31
Investment in the area of the	31
32. The thirty-second part of the report - The thirty-first investigation	32
Investment in the area of the	32
33. The thirty-third part of the report - The thirty-second investigation	33
Investment in the area of the	33
34. The thirty-fourth part of the report - The thirty-third investigation	34
Investment in the area of the	34
35. The thirty-fifth part of the report - The thirty-fourth investigation	35
Investment in the area of the	35
36. The thirty-sixth part of the report - The thirty-fifth investigation	36
Investment in the area of the	36
37. The thirty-seventh part of the report - The thirty-sixth investigation	37
Investment in the area of the	37
38. The thirty-eighth part of the report - The thirty-seventh investigation	38
Investment in the area of the	38
39. The thirty-ninth part of the report - The thirty-eighth investigation	39
Investment in the area of the	39
40. The fortieth part of the report - The thirty-ninth investigation	40
Investment in the area of the	40
41. The forty-first part of the report - The fortieth investigation	41
Investment in the area of the	41
42. The forty-second part of the report - The forty-first investigation	42
Investment in the area of the	42
43. The forty-third part of the report - The forty-second investigation	43
Investment in the area of the	43
44. The forty-fourth part of the report - The forty-third investigation	44
Investment in the area of the	44
45. The forty-fifth part of the report - The forty-fourth investigation	45
Investment in the area of the	45
46. The forty-sixth part of the report - The forty-fifth investigation	46
Investment in the area of the	46
47. The forty-seventh part of the report - The forty-sixth investigation	47
Investment in the area of the	47
48. The forty-eighth part of the report - The forty-seventh investigation	48
Investment in the area of the	48
49. The forty-ninth part of the report - The forty-eighth investigation	49
Investment in the area of the	49
50. The fiftieth part of the report - The forty-ninth investigation	50
Investment in the area of the	50

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CONTENTS

Abbreviations used in the text	VIII
Note to the reader	VIII
Acknowledgement	IX
 1 INTRODUCTION	 1
1.1 The Work Environment in Sweden - Development and Present Situation	2
1.2 Economic Analysis of the Work Environment - Some Conceptual Issues	10
1.3 Framework: Assumptions and Definitions	15
The Individual Employee	19
The Firm	24
The Composition of the Labour Market Contract	27
1.4 Plan of the Study	30
 2 COMPENSATION FOR NEGATIVELY VALUED WORK ENVIRONMENT CHARACTERISTICS	 41
2.1 The Provision of Compensation	45
2.2 Swedish Policy Measures Pertaining to the Compensation Issue	49
2.3 Effects of the Compensation Policy	52
Resource Allocation between Industries and Firms	53
Resource Allocation within Firms	55
Implications for the Incentives and Welfare of Employees	66
2.4 The Labour Market Insurances	77
 3 WORK ENVIRONMENT REGULATIONS AND ECONOMIC INCENTIVES	 87
3.1 Work Environment Regulations in Sweden	90
3.2 Regulations as a Perfect Substitute for Negotiations	94
3.3 Regulations as a Measure to Increase Work Environment Quality	96
3.4 Effects of Regulations in the Case of Full Compliance with Uniform Regulations	100
Resource Allocation between Industries and Firms	101
Resource Allocation within Firms	103
The Individual Employee and the Employment Contract	104
Increasing Work Environment Quality by Coercion	109
Summary of Effects	112

3.5 Work Environment Regulations with Partial and Negotiated Compliance	113
Enforcement Strategies in Sweden	115
Enforcement as a Bargaining Game	118
Local Variations in Work Environment Quality - Non-Uniformly Applied Regulations	124
Effects of Work Environment Regulations with Partial and Negotiated Compliance	125
3.6 Variable Product Prices	128
3.7 Taxes and Subsidies as Work Environment Policy Measures	129
3.8 Economic Incentives in Swedish Work Environment Policy	134
The Swedish Experiment with Work Environment Subsidies	134
Analysis of Subsidies to Higher Levels of Work Environment Quality	138
Concluding Remarks on the use of Taxes and Subsidies in Work Environment Policy	145
4 RESEARCH AND INFORMATION CONCERNING THE WORK ENVIRONMENT	159
4.1 The Case for Public Intervention In the Area of Work Environment Research	161
Is Work Environment Research Relatively Under-supplied?	163
The International Perspective	166
Influences of Other Work Environment Policy	168
4.2 Information Processing	170
4.3 Publicly Financed Work Environment Research and Information	172
4.4 Effects of the Present Research and Information Policy	175
Effects of the Work Environment Research Policy	176
Direction of Efforts	176
Centralization of Efforts	178
Efforts Directed by Public Agencies	178
User Influence	180
Effects of the Policy Concerning Dissemination of Information	181
4.5 Concluding Discussion on Research and Information Policy	183

5	WORK ENVIRONMENT INFLUENCE FROM OTHER POLICY AREAS	191
5.1	The Swedish Tax System and the Work Environment	193
5.2	Government Support to Economic Activities	196
5.3	Markets with Less than Full Competition	197
5.4	Labour Market Negotiations	199
	Legislation Concerning Labour Market Negotiations	200
	The Bargaining Process	204
	Regulations as a Trade Union Strategy	205
5.5	Concluding Remarks	207
6	DISCUSSION OF SWEDISH WORK ENVIRONMENT POLICY	214
6.1	Brief Summary of the Major Effects of Swedish Work Environment Policy	214
6.2	Some Suggestions for Policy Evaluation	220
	Work Environment Policy as Potential Pareto Improvement	221
	Resource Allocation between Industries and Firms	221
	Resource Allocation within Firms	224
	The Situation of the Individual Employee	235
	Limits to Individual Risk-taking	237
	An Alternative Perspective on the Value of Life	240
6.3	Concluding Remarks	244
	APPENDIX 1: Mathematical Derivation of Some Basic Results	248
	APPENDIX 2: Collectively Financed Expenditure Related to Variations in Occupational Safety and Health: A Case Study of Differentiated Insurance Premiums in Sweden	284
	APPENDIX 3: A Different Perspective on the Value of Life	295
	REFERENCES	310

ABBREVIATIONS USED IN THE TEXT

AGS	Sick pay and disability pension insurance (<u>Avtalsgruppsjukförsäkring</u>)
AML	The Work Environment Act (<u>Arbetsmiljölagen</u>)
ASF	The Swedish Work Environment Fund (<u>Arbeterskyddsfonden</u>)
ASS	The National Board of Occupational Safety and Health (<u>Arbeterskyddsstyrelsen</u>)
HI	Health Insurance
ISIC	International Standard Industrial Classification of All Economic Activities
OSHA	The Occupational Safety and Health Administration (U.S.A.)
SEK	Swedish crowns; in 1984 \$1 U.S. was equivalent to between 8 and 9 SEK
SNI	Swedish Standard Industrial Classification of All Economic Activities (<u>Svensk standard för näringsgrensindelning</u>); this corresponds to ISIC (1968 version) at the four-digit level (with minor exceptions)
TFA	No-fault liability insurance for occupational injuries (<u>Trygghetsförsäkring för arbetsskador</u>)
WE	Work Environment
WII	Work Injury Insurance
YI	Labour Inspectorate (<u>Yrkesinspektionen</u>)

NOTE TO THE READER

Parts of the text are set with a different vertical pitch (reduced space between the lines). The material in these passages is not essential to the development of the main ideas in the study.

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Needless to say, all remaining errors are the sole responsibility of the author.

Lund, October 1985

Carl Hampus Lyttkens

1 INTRODUCTION

This is a study of the incentives generated by several work environment policy measures. Consequently, the study will be primarily concerned with the structural properties of the social system that determines the work environment. Given a number of behavioural assumptions, this also will increase our knowledge of the concrete effects of Swedish work environment policy. At the same time, it will provide a sounder basis for more empirically oriented work.

It should be emphasized that the purpose of this study is not to define or describe an optimal work environment. Instead, the aim is to discuss the effects of policy measures directed at the work environment (henceforth abbreviated WE), given the institutional and socio-economic setting. We focus on situations where increased expenditure to raise the quality of the WE decreases profits, so that there is a conflict of interest between the employer and the employees. The distribution of company expenditure on different items will then be affected by the policy measures.

For several reasons, the WE is an area of major public concern. Obviously, the WE is an important determinant of individual and social welfare - we spend roughly half our conscious time at work for forty to fifty years. Much attention is being paid to the large number of people that are injured at work each year, and also to the fact that many are dissatisfied with their WE. This state of affairs may be seen as the driving force behind the increased public policy concern with the WE. This is not necessarily so, however, given the particular setting for WE quality determination.

The employer and the employee is bound together by a contract, voluntarily entered into by both parties. This contract has both explicit and implicit dimensions.¹ It is of fundamental importance for a discussion of the WE that it represents a significant portion of this contract. External influences on the contract affect the WE. Conversely, policy measures that aim to change the WE will have their effect through the contract.

"Work environment" is a vague and possibly all-encompassing concept. In this study, we will deal only with the physical shaping of places of work. Our main object is to examine policy measures that are closely connected to this aspect of the WE. We will discuss their effects on the physical shaping, as well as the implications for the welfare of the individuals concerned.

The analysis to follow is essentially partial. We do not propose to discuss all policy measures of importance for our chosen aspect of the WE. Nor will we use anything approaching a full general equilibrium framework.

We begin this chapter with a presentation in section 1.1 of some background material on the development and present state of the WE in Sweden. Some underlying causes for the development are briefly noted.

In section 1.2, we will then dwell more extensively on the conceptual issues indicated above. Several minor ones will also be raised. The general limits for our work are delineated in this discussion. Section 1.3 is devoted to a presentation of definitions and the specific assumptions retained throughout the study.

No survey of the economics literature on WE issues is undertaken. Instead, the relevant works will be taken up in their proper context during the analysis. However the major themes covered in this literature that fall outside the scope of our discussion will be briefly noted.²

Finally, we provide a brief outline of the study in section 1.4. (A summary of the main results is found in the last chapter.)

1.1 The Work Environment in Sweden - Development and Present Situation

We begin this survey with an examination of the present situation regarding the WE in Sweden. Table 1.1 gives a selected number of indicators. In 1981, almost 100,000 occupational accidents occurred among employees. Assuming that no employee had more than one accident, this would imply that 3.0 percent of all employees were victims of

occupational accidents during 1981. In the same way, 0.5 percent of all employees can be estimated to have contracted an occupational disease. Of the accidents, 133 were fatal, which is a sizeable figure for a country with 8 million inhabitants. It represents 1.2 percent of the deaths of persons of working age (15-64). However it is still far less than the number of deaths due to road accidents, which is one of the largest causes of violent death. In 1981 there were 973 fatal cases.³

Table 1.1: The Work Environment in Sweden - Present State

"Objective measures" (all employees)	number of occupational accidents (1981)	97781
	of which fatal	133
	number of occupational diseases (1981)	17107
Information from interviews (blue collar workers)	percentage troubled by (1980):	
	loading	71
	noise	54
	draught	45
	eczema	43
	temperature	42
	dust	26
	vibrations	24
	gases	21
	lighting	21
	stress	52
	percentage with performance related pay (1979)	24
	percentage with shift-work (1980)	10

Sources: Bolinder et al. (1981), pp. 20, 34.

Living Conditions. Report no. 32. Working Environment 1979,
Table 10.2, p. 177.

Occupational Injuries 1981, Table 1, p. 104.

Note: The above is only a minor selection of measures, especially as regards the psycho-social aspects. For further information, the reader is referred to the sources above, and to Eriksson and Aberg (1984) pp. 121-139.

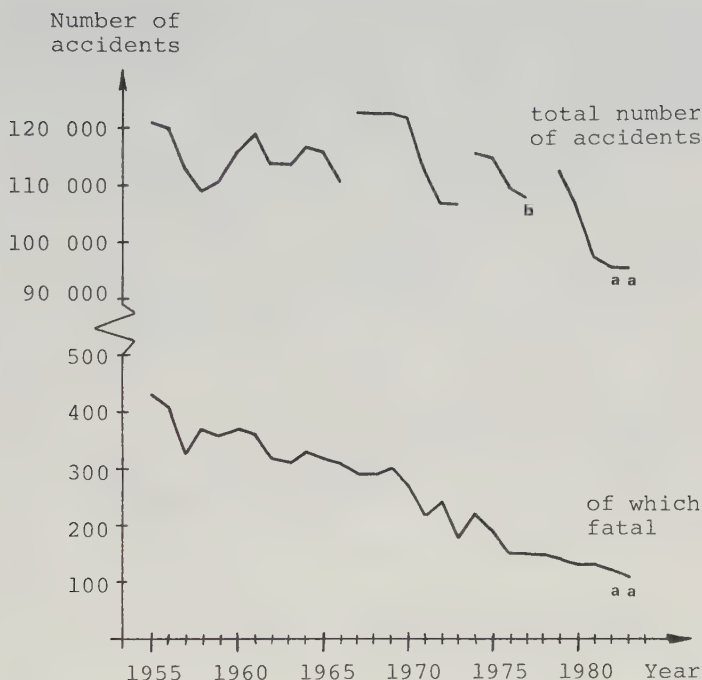
Some data from interviews are presented in the lower part of Table 1.1. They indicate that there is considerable scope for improvements in the WE. Problems of interpretation of subjective data from interviews are well-known. As our purpose here is merely illustrative, we need not however bother with these issues.⁴

Let us now turn to look at the changes that have occurred in the WE in Sweden. We start with occupational injuries. Figure 1.1 shows the number of occupational accidents since 1955. Note that each break in the curve implies non-comparability between sub-periods. Changes in the total number of accidents is difficult to interpret because of deficiencies in the statistical material. It appears that the number of accidents may have been falling since around 1970. The number of fatal accidents has been steadily decreasing, though the trend has evened out during later years. (Note the change of scale on the vertical axis.)

Unfortunately, there is no point in showing a similar figure for the total number of occupational diseases. Judged by present standards, these were severely underregistered before the enactment of the Work Injury Insurance Act in 1977.⁵ There are still great informational problems connected with these cases. The notion of what constitutes an occupational disease is still changing.⁶

Changes in the injury frequency rate are of greater interest than the absolute number of injuries. We confine our attention to occupational accidents, because of the problems with statistics on diseases noted above. Figure 1.2 shows the changes that have occurred in the accident frequency rate for the whole economy 1918-83,⁷ and for the industrial sector 1960-83.⁸ Again, different sub-periods may not be compared. The 1967 and 1974 institutional changes led to increases in the number of reported accidents (see comments to Figure 1.1). The "real" frequency rate may therefore be assumed to be the same 1967-1970 as in 1966 (Occupational Injuries 1975, pp. 21-22). The change in 1974 was the major cause behind the apparent increase in frequency rate that year (*ibid.*). For the whole economy, the frequency rate has been decreasing since the fifties. This is at least partially due to changes in the structure of the economy: a steadily increasing service sector, and an industrial sector that peaked in employment around 1960. As can be

Figure 1.1: Number of occupational accidents in Sweden 1955-1983, employees



Sources: Industrial Injuries, for the years 1955-1972; Occupational Injuries, for the years 1972-1975; Occupational Injuries 1976 - June 1977; Occupational Injuries July 1977 - 1978; Occupational Injuries, for the years 1979-1981; Arbetsskador, 1982, preliminär sammanställning; Arbetsskador 1983, preliminär sammanställning

Comments

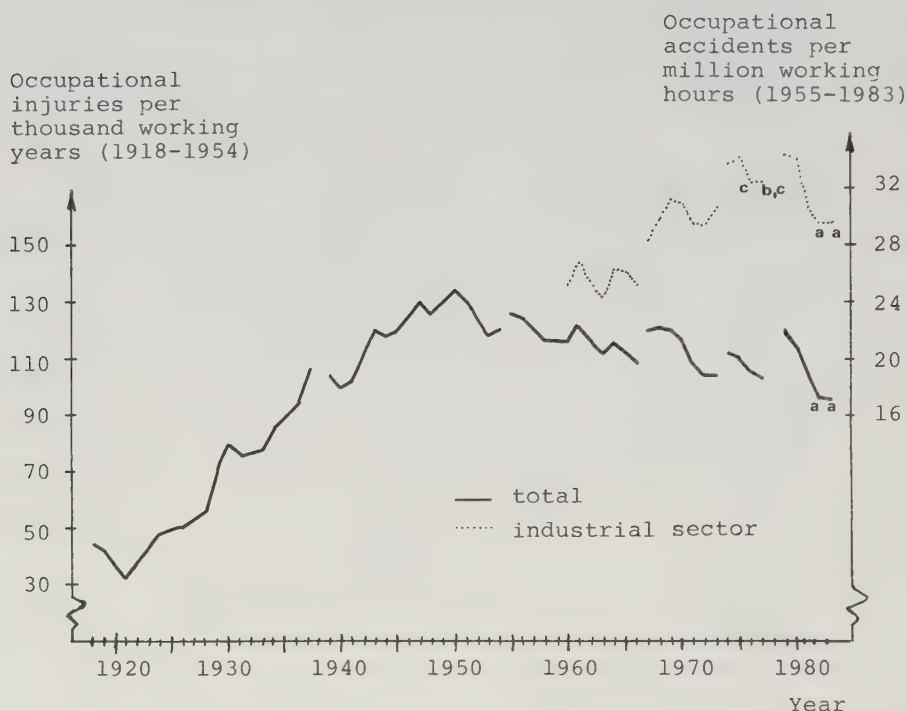
- 1967: Fewer waiting days led to an increase in the number of reported accidents.
- 1974: A change in the private insurance coverage led to an increase in the number of reported accidents.
- 1977: New Work Injury Insurance from July 1977. The changed definition of work injury should have had relatively little impact on the number of registered accidents.
- 1978: Comparable figure not available for the total number of accidents.

The 1967 and 1974 changes should almost exclusively have affected the number of reported non-fatal accidents.

Notes

- a Preliminary
- b Calculated as the number of accidents reported January-June 1977 multiplied by two.

Figure 1.2: Accident frequency rate in Sweden (1918-1983), and in the Swedish industrial sector (1960-1983), employees



Sources: Olycksfall i arbete, for the years 1918-1947 (sometimes revised more-than-one-year compilations have been used);
Industrial Accidents, for the years 1948-1954.
 For the years 1955-1983, see Figure 1.1.

Comments

1918-1954 occupational diseases and commuting accidents are included.

1938: No figure available.

1955: Total re-arrangement of statistics on occupational injuries. New frequency rate measure is introduced (see the figure).

1978: Comparable figures not available.

1967, 1974, and 1977 institutional changes - see comments to Figure 1.1.

The industrial sector is here defined as ISIC 1958 groups 1, 2, 3 and 5 (excl. 522) for the years 1960-1978, and as SNI (ISIC 1968) groups 2, 3 and 4 for the years 1979-1983.

Notes

a Preliminary

b Based on the data for January-June 1977.

c Calculated from Occupational Injuries 1976 - June 1977, Table E, p. 23, on the assumption of a fixed relationship between the frequency rates in the industrial sector and in manufacturing.

seen, the frequency of accidents in the industrial sector has not shown any particularly clear trend since 1960.

Another measure that is often used in occupational injury statistics is the severity rate. This is designed to reflect the number of working days lost per 1,000 working hours. Thus it measures not only the number of accidents, but also their severity. The severity rate k is defined as

$$k = 1/T (S \ 300/365 + I \ 75 + D \ 7500)$$

where T = thousands of working hours

S = number of days of sickness

I = number of cases of disability x average percentage
disablement

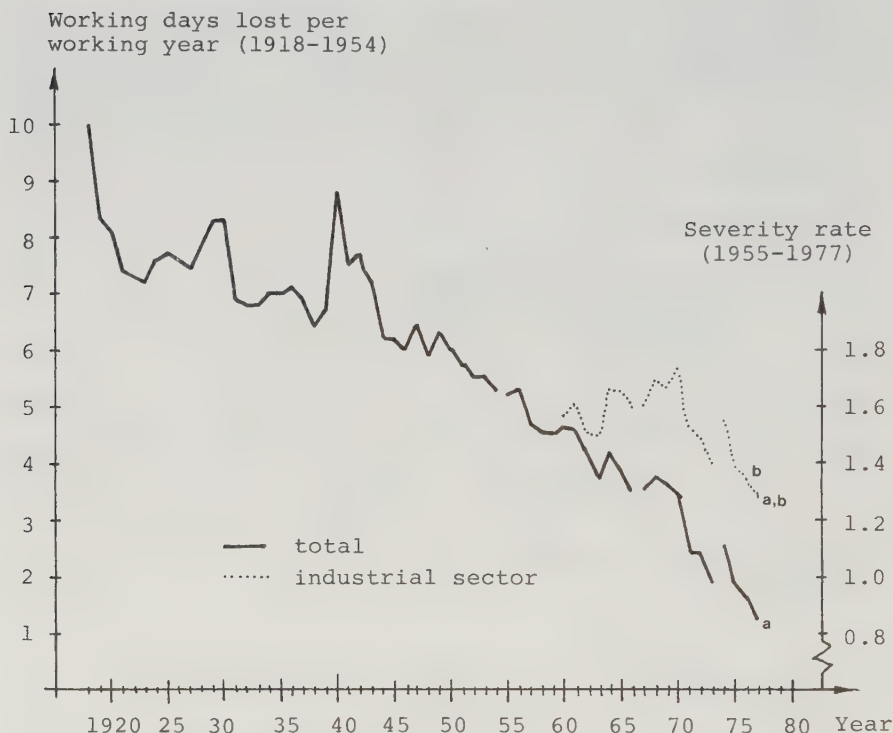
D = number of fatal cases

Changes in this measure for the years 1918-77 for the whole economy, and from 1960⁹ for the industrial sector, are presented in Figure 1.3.¹⁰ (For the period 1918-54 a slightly different but similarly constructed measure is used.) The severity rate has been decreasing since the war for the whole economy, and during the seventies for the industrial sector.

It must be pointed out that these aggregated figures conceal large differences between particular industries (not to mention individual firms). For example, the accident frequency rate ranged in 1980 from 127.7 for slaughter-houses to 1.5 for banking and insurance companies.¹¹

To assess the changes in the WE from interview material is very difficult.¹² The main trend in Swedish investigations of this kind is that employees experience the physical shaping of the WE as worse around 1980 than they did around 1970.¹³ However this is not necessarily due to a deterioration in WE conditions. Expectations may have changed etc. etc. Nevertheless, according to Living Conditions. Report no. 32. Working Environment 1979 (pp. 10-13) it is fairly certain that there was increased exposure to some negatively valued WE characteristics in this category. On the other hand, the opposite has happened with a number of psycho-social factors, such as increased influence over one's own situation at work and less piece rate work (ibid.). In the interviews conducted by the Confederation of Trade Unions (LO) in 1980, members and safety stewards were asked directly about the changes in the WE. It was generally considered that

Figure 1.3: Working days lost per working year (1918-1954), severity rate (1955-1977), in Sweden, and severity rate (1960-1977) in the Swedish industrial sector



Sources: See Figures 1.1 and 1.2

Comments

1918-1954 occupational diseases and commuting accidents are included. The figures refer to employees of larger employers, exclusive of state employees. The increase 1929-1930 is due to institutional change (Moberg et al., 1982, p. 69).

1955: Total re-arrangement of statistics on occupational injuries. New severity measure is introduced (see the figure).

1967, 1974 and 1977 institutional changes - see comments to Figure 1.1. Note that these only marginally affected the severity measure, which is mostly determined by reporting of severe accidents.

1977: A new definition of disablement was introduced from July 1977. After that date no severity measure comparable to the old ones can be calculated.

On the definition of the industrial sector - see comments to Figure 1.2.

Notes

a Based on the data for January-June 1977.

b Calculated from Occupational Injuries 1976 - June 1977, Table E, p. 23, on the assumption of a fixed relationship between the severity rates in the industrial sector and in manufacturing.

improvements had occurred although this was less evident in the case of psycho-social factors (Bolinder et al. (1981), pp. 176-177).

Notwithstanding the ambitious nature of these investigations they do not deal with the quality of the human relationships formed at the workplace.¹⁴ This is a drawback, since I would go so far as suggesting that this is probably one of the single most important WE factors in terms of the welfare of the individuals at work. However, it may be understandable in view of the fact that this aspect of quality of work is essentially impervious to public policy. External factors can influence the general conditions under which relationships between individuals are formed,¹⁵ but not their actual formation.

It is also difficult to find information on changes in positively valued WE characteristics, such as lunch rooms and sporting facilities. This is unfortunate, since these may be of equal importance to the negatively valued ones, judged either by contributions to individual welfare or by the size of investment costs.

The changes in the WE portrayed above depend on a large number of factors. It is the interplay of these factors that determines the WE. There is no a priori possibility of attributing changes in the WE to any specific factor, such as changes in safety and health regulations.

There are many influences operating at the same time. (Some have been noted already.) Among the factors at the macro level that affect the WE are the following:

- structural change including a growing service sector,¹⁶
- technological development,¹⁷
- stage of the business-cycle,¹⁸ and
- taxation policy.

Indeed it is of fundamental importance to realize that the level of WE quality - such as the magnitude of occupational hazards - is mainly determined by factors that fall outside the scope of traditional regulatory policy (Lindeneg, 1984, p. 105) such as long run technological development and existing practices regarding organization of work (Om statligt stöd till arbetsmiljöinvesteringar, pp. 9-10). This also implies that policy measures that affect the direction of these long run trends - even if only slightly - may wield

a very strong influence on the WE in a longer perspective.

Turning to a disaggregated level, one realizes that the WE of a particular firm or industry is also influenced by many other factors,¹⁹ such as the more direct effects of WE policy. We need not go into detail here. One of the main objects of our study is to clarify the interplay between some WE policy measures. However there is still a long way to go before we can separate the effects of all the relevant factors.

1.2 Economic Analysis of the Work Environment - Some Conceptual Issues

Generally speaking, the work environment is but one of the aspects of work. However, it is an open question what should be included in this concept. To my knowledge, the most all-encompassing definition requires the inclusion of all factors in the situation at work that affects the individual positively or negatively, either physically or mentally.²⁰ It is evident that this definition makes virtually every aspect of work part of the WE - for example, the level of wages.

However, to stretch the concept that far would seem to be contrary to our common sense notion of the concept. In any case, we must restrict ourselves to only a certain aspect of the WE; namely, its physical shaping. Although it would of course be desirable to also include other aspects, this is not possible within the scope of this study.²¹ On the other hand, it would not be appropriate to restrict the analysis to matters of occupational safety and health, despite the fact that these are the two themes usually associated with the concept of WE, as well as the two most common in economic analysis of the WE. The Swedish WE policy also takes explicit account of other factors.²² Hence we also try to include other aspects of the physical shaping. However there is an inevitable concentration on occupational hazards, since this is the main concern of the public policy measures to be analyzed.

It is important to note that the physical aspects of the WE, delimited in this way, include both elements that ceteris paribus have a negative impact on individual welfare, and elements that have a positive impact. This is of considerable importance for the analysis

to follow. (In principle, they could, of course, be seen as just two sides of the same coin, since the absence of something unpleasant is positive, and vice versa.)

The aim of this study is to examine the effects of some policy measures that are of significant importance in connection with the physical shaping of the WE. Under ideal conditions, the effect of a policy measure can be inferred by comparing the situations before and after its enactment. Unfortunately, this requires that all other factors that could influence the situation remain unchanged. When we are dealing with major policy instruments this is typically not the case. The ceteris do not remain paribus. Therefore the present analysis is restricted to the study of structural rather than specific phenomena. The basic theme of our study is an investigation of the incentives given to the individual decision-maker in the Swedish system - not the concrete results of different reforms. In fact, the kind of analysis presented here is a prerequisite for a study of such concrete effects, which is then a possible later step.

Behavioural assumptions for the decision-makers are added to the incentive effects. This enables us to make qualitative statements regarding the effects on the WE. However we stop short of the empirical (quantitative) level. As I understand it, this removes us further from the categories of evaluation studies and implementation studies respectively.²³ The object of this study is perhaps most properly called the construction of a model of causality (cf. Nilstun and Hermerén, 1984). In other words, we try to show how and why different factors influence the WE.

This is not to deny that occasionally it might be possible to distinguish the effects of a well-specified policy measure, such as a regulation. This is particularly the case if it is highly limited in scope. However changes in the incentive structure are a much more powerful policy instrument. Consequently, it seems natural to give first priority to the analysis of the latter.

The evaluation perspective also favours the incentives approach. In general, this is obvious, because as noted above a structural background is needed to identify the effects on the WE. Furthermore, an evaluation in total welfare terms requires that account be taken of

the impact on other parts of society, which also favours this approach. Ahonen (1981) argues that "...labour protectional measures should, to a much greater extent than²⁴ hereto, consist of indirect measures aiming at the creation of welfare optimizing structures in the society." (Op. cit., p. 90.)²⁵ This is explained in terms of the generally ambiguous welfare effects of piecemeal strategies which generate conflicts that are difficult to solve at a policy level. These problems follow from the complexity of the economic system. For example, any change in law or regulation will normally have repercussions throughout the economy. (See Ashford et al. (1980) for a good survey of possible effects.) Most regulations concerning occupational safety and health, for example, must be assumed to increase production costs.

Even when these structural problems are solved, it is a formidable task to perform the formal economic evaluations of specific WE policy measures. This is extensively discussed in Ashford et al. (1980), Lindeneg (1984) and Jeppesen (1982).²⁶ Conceptual problems with the benefit-cost approach to WE regulations are discussed in Ahonen (1983, pp. 14, 31sq., 63). The total social costs of occupational injuries in Sweden have been estimated by Jonsson (1974a).²⁷ General methods for evaluation of reforms in working life are analyzed in the reports from the MURA project.²⁸ We will not dwell further on these points, since evaluation issues largely fall outside the scope of our study.

In relation to previous literature in this area, the main advantage with the approach used here is that it enables us to sketch the simultaneous effects of a whole set of policy measures, rather than selected aspects. It is hoped that this more comprehensive view of the policy area will provide some new insights into the subject.

Nevertheless the analysis still remains partial. Given the complexity of the social system that we are attempting to describe, the scope of the study has consequently had to be restricted. This inevitably implies that all results must be treated with caution.²⁹ However to gain knowledge of the part brings us closer to an understanding of the whole.

In general, we will not attempt to trace the effects of WE policy measures in non-WE areas.³⁰ Our more limited ambition is the following. The analysis will be conducted along three lines. The first is the direct effect on (decisions on) the WE. Secondly, we will discuss how the situation of the individuals concerned is affected by these policy induced changes. After all, the WE has no intrinsic value, but is only valued in relation to those who experience it.³¹ However, public concern with the WE has two dimensions. One is the aforementioned welfare of the working individuals. The other is "work environment in the aggregate." In other words, what is the general state of the WE in Sweden, taken as a whole? How many people are injured each year? etc. With this approach, we study the resource allocation between firms and industries that differ in some important WE aspects.³²

Although this latter effect concerns the macro level of the economy, macro policy measures will not be discussed here. This is explained by the simple reason that such measures have not been used (as WE policy) in Sweden. An overview of some macro approaches is given in Lindeney (1984, ch. 6).³³

In order to discuss the effects of certain policy measures, it is necessary to specify an alternative situation, against which to make the comparison. This choice of yard-stick is essentially arbitrary. The decision made on this point is therefore clearly a value judgement; this should be kept in mind.

With one exception (which will be explained below), I have chosen to analyze the effects of Swedish WE policy compared to the alternative of no public intervention. This would appear to me to be the sensible thing to do. It would be difficult to argue for any other specific point of comparison, such as another policy mix. In addition, the no-intervention comparison is probably the least confusing one.³⁴

It should also be pointed out, that we view the WE issues as a source of conflict and controversy between employers and employees. As pointed out by other analysts of the AML (e.g., Björkman and Lundqvist (1981) pp. 7-16, Lundberg (1982) pp. 42-45; also Nordfors (1985)), this approach is necessary for our understanding of the WE area. I assume that the economist needs no further convincing on this point.

This is of course not to deny that mutually beneficial measures can be taken, and that the potential for this type of measure may have been underestimated in the past (and possibly still is).³⁵ Policy measures that facilitate cooperation between employer and employees may thus be important for the determination of the WE.³⁶ These are of less interest in the present context, however, since we will exclusively deal with the case where WE improvements have been carried to the point where opinions diverge. (This is further specified in section 1.3.)

An important aspect of the analysis in this study is that it is basically individualistic. It is concerned with the welfare of individuals, as judged by their own preferences. A free choice of the individual in accordance with his/her preferences is taken to be beneficial. The evaluation of government actions should then be based on the preferences of individual citizens.

Furthermore, it is assumed that each individual derives utility only from his/her own situation - altruistic motives are not taken into consideration. No intrinsic value is given to the interpretation of equity as the equal provision of individual items. The existence of identical WEs does not increase individual utility. Indeed, in so far as their preferences differ, such equal provision will solely be a source of disutility.

Another basic feature is that the situation of the employee is studied in an ex ante setting; that is, before the sequence of future consequences for the individual is known. These depend on stochastically occurring states of the world (cf. section 1.3). For example, a risk reduction is valued by all concerned, not just those who ex post have not been injured.

As noted above, we will examine the effects of various policy measures that have a significant impact on the physical shaping of the WE. We

will analyze the effects of five sets of WE policy measures. In order of appearance these are:

Social Insurances (the Work Injury Insurance and the Health Insurance),

regulation (mainly the Work Environment Act),

economic incentives (subsidies to work environment investments),

work environment research, and

dissemination of work environment information.

This selection still leaves aside a number of potentially relevant areas of WE policy, to which only occasional references will be made. Among these are the type of wage payment, working hours, job security, and direct employee influence on company decisions. These are all important factors in the psycho-social aspects of the WE. However, they also influence the physical shaping of the WE. Job security, for example, through its impact on labour turn-over, affects the return to WE investments. (This is extensively discussed in Viscusi (1979a).) Similarly connections with the physical aspects of the WE could be outlined for the other omitted areas that have been mentioned. However, there is no need to extend this discussion. I would argue that the measures selected for analysis have generally speaking a more direct impact on and are more intimately connected with the physical aspects of the WE. Hopefully, this will become clear in the discussions below.

1.3 Framework: Assumptions and Definitions

In this section we will outline the basic framework for our analysis of WE policy. It largely follows the lines suggested in Ståhl (1972). We note here the assumptions upon which we base our discussion of these issues. The framework is presented in formalized terms. This mode of description is mainly chosen for brevity and clarity. We hope to give a lucid view of the structure of the decision-making process. The mathematical model will not be used for analysis in the main text. It is utilized, however, in Appendix 1, for the formal derivation of some basic results. The most important assumptions are summarized in Table 1.2.

Table 1.2: Basic assumptions (notations see pp. 18-19, 24-25)

General

1. There is uncertainty about future states of the world.
2. Everybody has the socially optimal amount of information.

Conditions of employment

3. The employment contract is multidimensional and has both explicit and implicit components. We can see it as a vector $(w, c_y, x_1, \dots, x_n)$.
4. The wage is set per time period worked.
5. Hours of work is exogenously given.

The individual

6. The individual seeks to maximize utility given by the employment contract $U(w, c_y, X)$.
7. The (cardinal) utility function is specific to the individual and depends on the state of the world.
 $\partial U / \partial c_y > 0, \partial U / \partial w > 0, \partial^2 U / \partial w^2 < 0$ (individuals have risk aversion).
8. No altruism.
9. Individuals { have unbiased risk perceptions
underestimate risks

The firm

10. The product price is exogenously determined.
11. The firm seeks to maximize return to capital (profits).
12. Return to capital is given by the value of production, less wages, costs for increasing WE quality, accident costs, etc., viz.:
 $P = F(L-y, y, X) - (L-y)w - [p_i c_i - p_y c_y - A_y]$
 $\partial P / \partial c_y < 0, \partial P / \partial c_i < 0$ (for work environment quality).
13. Work environment decisions taken by the employer are characterized by risk neutrality, unless the risk is uninsurable.

The labour market

14. P tends toward "normal return to capital" at the margin; however, there is some scope for shifting P, especially in the short run.
15. The utility the employee derives from the employment contract tends to be given for the individual firm, ceteris paribus (totally elastic labour supply); however, there is some scope for shifting U.
16. As implied by 15, the costs of work environment improvements tend to be shifted to employees to the extent that they are valued by them.
17. Payroll taxes are { totally shifted to employees
less than totally shifted to employees

Note: On points 9 and 17 the underlined assumption is the main alternative used. However, the implications of the other alternative will also be noted.

The strictly formal presentation of our framework should not be taken to imply that this is a close approximation of specific aspects of reality. Rather, it should be thought of as conveying ideas about some important tendencies.

We begin by noting a few general assumptions. First, we live in a world of uncertainty. In this WE context, it is convenient to express this uncertainty as a lack of information on future states of the world. A number of possible states of the world can be identified (sometimes all), but it is not known for certain which state will occur. The relative probabilities of the states of the world are also not known with precision. This will affect our decision-making, and we will often return to this aspect of the decision problem below.

How well-informed are decision-makers? The provision of information is generally considered to be an important task for the government. This policy issue is discussed in Chapter 4, where the situation in Sweden is also examined. Elsewhere in the study, it is assumed that everybody is as well-informed as it is socially desirable for them to be i.e. social welfare cannot be improved by implementing a policy aimed at creation or dissemination of information. This, of course, is not to say that everybody or anybody would be fully informed. On the contrary, we will assume that individuals generally do not possess perfect information.

The WE can be seen as a part of the relationship between employer and employee. This relationship is usually contractual and of a long term nature. Both these aspects are worth noting.

Since it is a contractual relationship, all aspects of this relationship could in principle be fully specified in the contract. In particular, a complete contingent claim contract will take into account every possible future state of the world. As will be discussed below, the specification of the contract depends on a number of factors. To the extent that future states of the world are not taken into account, the value of the contract will be uncertain for both parties. This uncertainty would matter little if the contract was short term and was of negligible importance for the wealth of each party (see below on risk aversion). A non-satisfied party could then

choose to deal with somebody else the next time. In contrast, the employment contract is typically long term, particularly in Sweden. This is explained by a number of institutional and economic factors which have raised the opportunity cost of seeking new employment/new employees. It also involves a considerable part of the wealth of the employee. These aspects increase the value of a fuller specification of the contract.

The long-term nature of the relationship is the result of the employee staying with the same employer for a large number of periods.³⁷ To seek a change in the contract will often be a preferred strategy, rather than seeking a new contract partner. This also means that the parties will successively improve their knowledge of each other, and of the non-specified and implicit aspects of their relationship.

In general, we can specify the employment contract as a vector³⁸

$$(w, c_y, x_1, \dots, x_n)$$

where w is the wage, which we take to include all pecuniary benefits

c_y is the level of injury prevention

$x_1, \dots, x_n$ are all other aspects of the relationship.

Among $x_1, \dots, x_n$ we will find the other characteristics that constitute the WE. (Cf. the discussion on what to include in section 1.2.) Let these be $x_1, \dots, x_k$. It would have been more proper to have the injury risk here, instead of the level of preventive activity. However, this would complicate the notation without adding positively to the analysis. (The same is true for the utility function of the individual employee below.) Hours of work are assumed to be exogenously given.

The net benefit of employment is determined by the package of wage and other job characteristics. We assume that these job characteristics can be exchanged for wages, and for one another, in the determination of the contract. In other words, that there exists "... a market determined implicit price schedule for [...] job quality improvement." (Veljanovski, 1982a, p. 262.)³⁹

The uncertainty about the future has two important implications for the contract:

- 1) Should the remuneration of the employee depend on his/her contribution to production?
- 2) Should the remuneration of the employee depend on the state of the world in some other way?

The former would increase production efficiency, the latter could eliminate fluctuations in ex post utility. The answer to these questions have WE implications, both in their own right, and because of the incentives they create. In this study, we will only be concerned with the answer to the second question. As noted above, form of wage payment is not among the policy areas included in our analysis. Henceforth, the wage is assumed to be a constant per unit of time worked. This is by far the most usual form.⁴⁰

The Individual Employee

The individual employee is assumed to be a utility maximizer. The utility of the individual is influenced by many factors and conditions. In this study, our interest will be focused on a selected number of them. Thus, the individual is assumed to maximize

$$U(w, c_y, x_1, \dots, x_k, \dots, x_n).$$

The utility here may be thought of as the expected utility from the employment contract. This also applies, mutatis mutandis, in the discussions below. All individuals are assumed to have different (cardinal) utility functions. These depend on the state of the world.⁴¹ In other words, the utility of a given (w, c_y, X) depends on which state of the world has occurred. We use subscripts to denote individuals, and superscripts to denote different states of the world. Thus we have for a given (w, c_y, X) ⁴²

$$U_i^1(w, c_y, X) \gtrless U_i^2(w, c_y, X).$$

The difference in utility due to the state of the world can be negligibly small or quite important. The usual example of the latter is the case of occupational injuries. This is also the one that will be considered here. It seems reasonable to assume that the utility of money will be different depending on whether or not you have been injured. This is particularly the case with severe injuries. However,

the effect of injuries on the marginal utility of money is somewhat ambiguous. In other words

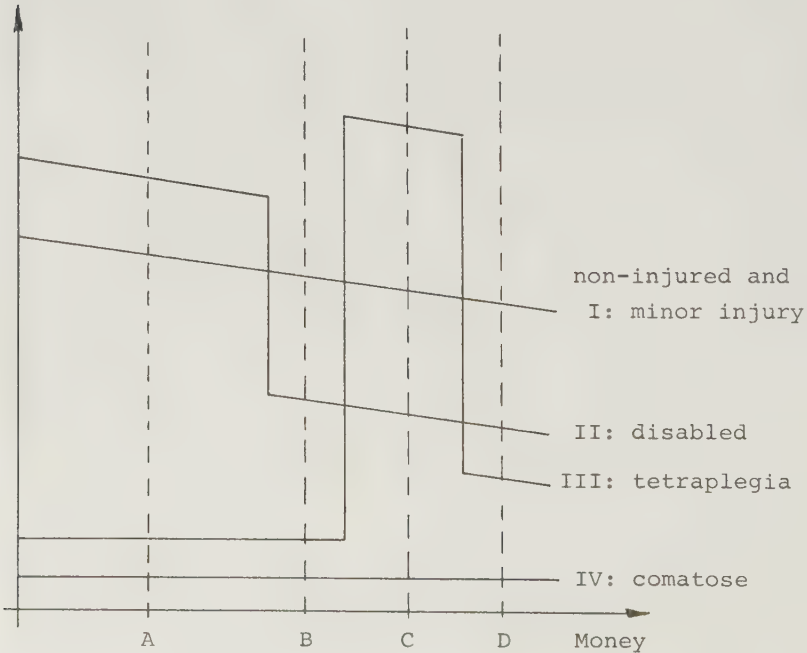
$$\frac{\partial U}{\partial w}^{\text{injured}} \begin{matrix} > \\ < \end{matrix} \frac{\partial U}{\partial w}^{\text{non-injured}}$$

Nor is it possible to present any a priori general statement on this.

Both views have been advocated in the literature.⁴³ What one really needs to do is to distinguish between different kinds of injuries. One also has to take the institutional setting into account. In Figure 1.4 we have sketched some possible alternatives. The numerals I-IV indicate different states of the world with respect to occupational injuries for one individual. Note that this is only an illustration of what the situation might be.

Figure 1.4: Marginal utility of money for one individual in different states of the world

Marginal
utility



For the most serious state of injury (IV), when one is not technically dead (e.g., a comatose individual), the marginal utility of money is arguably zero. Adequate health care is provided even when the individual lacks the means to support himself. For the same reason, tetraplegia (paralysis of all four extremities) may imply relatively

little use for money, unless it is sufficient to pay for private health care that offers special facilities (III). This "all or nothing" situation is partly due to the fact that relatively little "extra" can be obtained by payment in the public health service. However some improvements may be "privately" introduced. Next, in the case of a disabling injury, the availability of money may lead to a substantial increase in utility - buying special equipment, etc. - up to a level that reflects the fact that there are certain things that "money cannot buy" (II). A minor injury, finally, might not affect the marginal utility of money to any noticeable extent (I).

This short discussion has illustrated several points. Firstly, different injuries will not have the same effect on the utility of money. Secondly, the institutional setting is important, e.g. the provisions and statutes of the public health service. Thirdly, different answers are obtained depending on the range of money income in question (compare for example points A-D in the figure). All these aspects must be taken into account in any discussion of the marginal utility of money that applies to different types of injury. Moreover, on many points there will probably be no a priori agreement. Hence it will be necessary to consider different alternatives.

With respect to w we assume further that

$$\frac{\partial U_i}{\partial w} > 0, \quad \forall i, w \in [0, \infty).$$

Individuals are assumed to be risk-averse in the situations under consideration in this study.⁴⁵ This is a natural assumption, and the usual one in this context. It is often expressed as decreasing marginal utility of money (this mode of expression should not be taken to imply that risk aversion necessarily pertains only to pecuniary aspects):

$$\frac{\partial^2 U_i}{\partial w^2} < 0.$$

Among the WE components $(x_1, \dots, x_k)$ we will have both positively and negatively valued ones. Putting the latter as the first l ones, we will have

$$\frac{\partial U_i}{\partial x_j} < 0, \quad 1 \leq j \leq l_i$$

and

$$\frac{\partial U_i}{\partial x_j} > 0, \quad l_i + 1 \leq j \leq k.$$

The subscript on l reminds us of the fact that individuals' assessment of WE characteristics can differ not only quantitatively but also qualitatively. What one person likes another may dislike. In fact, we

cannot properly use the same ordering of characteristics for different individuals. However, these fine points of notation will be ignored.

We assume that workers are sufficiently alike, so that they agree in most cases on whether a job characteristic increases or decreases utility. In particular it is assumed that all employees dislike aspects of the WE that cause injury, disease, or sickness. Thus, we will have

$$\frac{\partial U_i}{\partial c_y} > 0.$$

One further aspect may be noted about the individuals. It concerns workers' perceptions of the risks for occupational injuries.⁴⁶ In principle, there are a number of risks for different kinds of injuries. A very important question is whether employees underestimate some or all of these risks. It is often assumed that they do, and we will argue below that this is quite reasonable. The preferences of individual employees are typically voiced through their union representatives in matters of occupational safety and health. In addition, we have assumed an "optimal" public information policy. Both these facts serve to counteract any tendency for under-estimation of risks.⁴⁷ Despite these mitigating circumstances, one can argue that decisions on behalf of employees will be characterized by under-estimation of risks. The consideration of these issues merits a short digression.

Let us begin with the employees left "un-attended". As mentioned, it is frequently assumed that workers underestimate the risk for occupational injuries. Many would probably agree with the observation of Akerlof and Dickens (1982) that "A great deal of anecdotal information suggests that workers in dangerous jobs are often quite oblivious to the dangers involved." (Op. cit., p. 307.) At the same time there is the possibility, discussed in Lyttkens (1982), that existential worries or worries that are due to changes in the value structure in society are focused in areas that seem to be under our control. Conceivably, this could in extreme cases lead to an over-estimation of occupational risks.⁴⁸ However, we will not discuss this possibility in our analysis.

It is also commonly observed⁴⁹ that workers who underestimate risks more will tend to work in risky industries.⁵⁰ The above quoted observation of Akerlof and Dickens would be valid in a situation where workers, on average, correctly perceive risks, but have individually biased estimates of these risks.

The claim that workers underestimate risks can be substantiated by resorting to the theory of cognitive dissonance. In my opinion, this represents a plausible description of the situation. The introduction of the concept of cognitive dissonance into economic analysis is due

to Hirschman (1965). The economic applications have been extended by Akerlof and Dickens (1982), who specifically discuss the case of occupational safety. The basic idea is that people view "... themselves as 'smart nice people' ..." and "... persons who have made decisions tend to discard information that would suggest such decisions are in error ..." (op. cit., p. 309). Particularly, "If the worker continues to work in the dangerous job, he will try to eject the cognition that the job is dangerous." (Ibid.)⁵¹

In addition, cognitive dissonance has clear implications for the way individuals process information. The model "... not only predicts systematic differences in interpretation of given information but also systematic differences in receptivity to new information according to preferences." (Ibid.) We shall soon see why this is important.

This is obviously a deviation from the standard assumption of rational behaviour otherwise retained in this study. If this is a true description of human behaviour, one might argue that it should be used throughout the analysis. To do so would amount to creating a new economic theory, however, and we have no such ambition. Moreover, as noted by Akerlof and Dickens, "For most types of economic behavior, the economists' model is probably quite adequate." (Op. cit., p. 307.) On the other hand, I agree with Akerlof and Dickens that, if one needs to discuss situations where cognitive dissonance is likely to have a major impact on individual behaviour, this aspect should where possible be incorporated in the analysis. It appears that the economics of occupational hazards is such an instance. In fact, Diamond (1977, p. 76) while not using this concept, adopts a similar standpoint. He argues that avoidance of rationality and "do not bother me with facts" reactions are likely to occur in the context of occupational hazards.

The individual's valuation of risk probably also depends on the degree to which s/he is in control of the situation. This will influence the effect of the risk on individual utility, and thus the compensation demanded to endure it. It may well be that we generally underestimate the risk in situations where we sense that we are in control (for example, by overestimating the degree of control), such as driving a car. Conceivably, many occupational accident risks belong to this category (Lindeneg, 1984, pp. 135-137).

Now, individuals' perceptions of risk are based on the information at hand. This information changes over time. Viscusi (1979a; 1983b, ch. 4; 1985) and Viscusi and O'Connor (1984) have emphasized that workers will learn about their job-risks through on-the-job experience.⁵² This may indeed be so.⁵³ In addition, the government can provide him/her with better information. We have assumed a "socially optimal" information policy, but in general it will not be socially desirable to try to provide workers with perfect information.

The question here is then if these two effects will induce employees' perceptions of risk to become unbiased. Again, given a wish to avoid cognitive dissonance, this would not be so. The case for the importance of cognitive dissonance is strengthened by the fact that the contractual relationship is a long term one. In particular that it is costly to break up. Diamond (1977, section 8) uses a similar assumption in that workers' perceptions are assumed to change proportionately less than increases in safety. (See also the Bayesian framework adopted in Viscusi (1985) and Viscusi and O'Connor (1984).)

Finally, we must consider the existence of trade unions. In many instances, the risk perception of the union representative is the relevant one for WE decisions. The union is likely to have considerably more information at its disposal than the individual employee. However, in view of cognitive dissonance, it does not seem likely that superior information on their part can wholly overcome the difficulties created by workers' misperceptions. On the positive side we note that the representative will (sometimes) be less personally exposed to the WE factors in question. On the other hand, the representative will probably have a preference for the belief that those s/he represents have been fully protected.⁵⁴ Furthermore, superior decisions on risk levels made by the representative either implies merit wants on the part of employees - which would again conflict with their preferred belief - or a paternalistic attitude. The scope for the latter depends on the political process within the union. If one does not accept the notion of cognitive dissonance, the case might be less clear.

Obviously, the whole issue of workers' perceptions of risk is very important for the analysis in this study. (Viscusi (1980a) has nevertheless shown that unbiased but imprecise information on the part of workers can produce many of the results associated with under-estimation of risk.⁵⁵) It may be concluded on the basis of the above discussion that the case of under-estimation of risk on the part of employees merits consideration. On the other hand, the existence of trade unions particularly suggests that unbiased risk perceptions are also a conceivable alternative.⁵⁶ To simplify our argument, we will henceforth take the latter as our standard case, and note how the results would be affected by workers' misperception of risks. In addition, cognitive dissonance will be discussed as a separate case in our discussion of information policy (Chapter 4).

The Firm

The production of a firm is taken to be a function $F(L-y, y, X)$,⁵⁷ where $L-y$ is the amount of (non-injured) labour and X is the vector $(x_1, \dots, x_n)$. y is the (expected) amount of labour lost from occupational injuries. We assume that y can be expressed as a decreasing function of c_y , with decreasing marginal return to preventive activity in terms of reductions in y . To obtain the value of the production volume, we multiply $F(L-y, y, X)$ with the product price. However, we lose nothing in generality (and gain in notational simplicity) by setting this price equal to one. Hence from now on $F(L-y, y, X)$ is taken to represent the value of production. For the most part, product prices are assumed as given for the individual

firm. Sweden being a small and essentially open economy, these circumstances apply to a substantial sector of the economy. (The scenario below is not directly applicable to public sector enterprises. The situation of the latter will be briefly discussed in section 5.3.) The value of production covers wages, costs for other worker related items, costs of accidents, and return to capital.

Occupational injuries may be of two kinds:⁵⁸ accidents and diseases. (In this study "injuries" refers to both kinds simultaneously.) Normally, occupational accidents entail costs both in terms of production stops, and costs that are not directly related to the production process, such as destroyed but replacable equipment, liability claims, hiring and training costs, etc.⁵⁹ The latter are denoted by the term A_y , where A is the average direct accident cost per unit of labour lost.⁶⁰ (Thus for the sake of simplification we do not differentiate between diseases and accidents on this point.)

The return to capital, P , can now be written as

$$P = F(L-y, y, x_1, \dots, x_n) - (L-y)w - p_i c_i - p_y c_y - A_y.$$

c_y represents as before units of injury prevention, while the c_i s represent units of other WE improvements. The p_i s and p_y are prices. There is a lower bound for P which we call $\underline{P}$, below which the firm will go into bankruptcy. The upper limit is given by $P = F(L-y, y, X)$. Between these extremes lies the "normal return to capital", P_0 , which is usually termed zero profits.

It should be noted that y in reality depends both on c_y and on the prevention activities of the employees. Our presentation will not be burdened with introducing this aspect in the notation. In the analysis, we will note where the influence of employee behaviour affects the results.

We deal only with the case where there are conflicting interests regarding the WE (cf. section 1.2) in the sense that

$$\frac{\partial P}{\partial c_y} < 0$$

$$\frac{\partial P}{\partial c_i} < 0 \quad \text{for } 1 \leq i \leq k$$

so that the cost of WE improvements exceeds their contribution to production.

In the short run, there can be considerable disagreement as to the size of P (and consequently of w , c_y and c_i). Workers prefer it to be close to $\underline{P}$, and employers seek to push it towards $F(\cdot)$. The latter is interpreted as a profit maximizing strategy.⁶¹ In the long run, we would expect P to lie in the vicinity of P_0 for new investments. However, given incomplete markets there will always be some scope for shifting P upwards and downwards.

WE improvements can be of both a short and long run nature. In either case, increasing c_y or c_i without at the same time lowering w would mean decreasing P . In extreme cases where large WE improvements occur without accompanying wage reductions, the firm would be pushed out of existence. This could happen both in the short run - P falling below $\underline{P}$ - and in the long run - P falling "too much" below P_0 . The relationship between company expenditures of different kinds will be discussed in the next sub-section.

One important question is whether the decisions of the employer will be characterized by risk neutrality. In economic analysis, both risk neutrality and risk aversion are intermittently assumed. There are good reasons for both assumptions.

On the one hand, firms "ought to" be risk-neutral. Otherwise, they would be at a disadvantage in relation to less risk-averse firms, and could be expected to be forced out of the market. Joint stock companies distribute risk between their shareholders, each of whom may carry a negligible part of the risk. At least, decisions by firms ought to be characterized by risk neutrality with respect to small investments⁶² and expenditures (that do not jeopardize their existence).

On the other hand, it is an empirical fact that they do not appear to behave as risk-neutral agents. For example, companies purchase insurances against losses which far from endanger their continued existence. This is not so easy to explain. One possibility is that insurance companies function as specialists in settling disputes between partners to a contract. To buy an insurance is then a superior alternative to: a) writing a complete contingent claim contract, or b) settling disputes over un-specified items through negotiations and/or court proceedings which involves the company itself.⁶³

Fortunately, for our purpose it is sufficient that the relevant decisions within firms are characterized by risk neutrality. And this will be so, precisely because an insured risk-averse agent will act like a risk-neutral one. A company will be willing to pay for the

insurance of risks to which it is markedly averse. An insurance market will emerge, and the firm will act in a risk-neutral manner. However full risk neutrality requires "perfect" insurances. This is naturally far from the case. Nevertheless, it is in my opinion a permissible simplification to treat companies as risk-neutral with respect to moderate costs in our context. (They are certainly less risk-averse than the individual employee.) Of course, if a risk is uninsurable, either because of the nature of the risk or because it is not permitted by law, then the situation is different.⁶⁴ (This exception will be of importance in Chapter 4.)

The Composition of the Labour Market Contract

In general, an employer cannot offer lower net benefits than other employers, *ceteris paribus*, if he is to attract workers to the company. As indicated above, a certain net benefit can result from different (w, c_y, X) packages. The general problem for the firm is therefore to maximize profits, subject to the constraint of fixed utility for the employees. However, just as the return to capital is not assumed to be fixed, we assume that there are certain limits within which the remuneration of employees may vary.

We will now briefly discuss some properties of this problem, beginning with the most simple case of a one man firm. Next we will introduce one employee, and finally the case of several employees will be considered.

For a one man firm there is no conflict between profits and expenditure on the WE, "fringe benefits", etc., since he receives all of the benefits himself. The only uncertainty is about which state of the world will occur. (However this can be offset by an insurance.) Profits will be perfectly balanced against WE improvements.⁶⁵

When employees are hired, things become more complicated. First there is the conflict between P and remuneration of the employees. Simultaneously one must determine the distribution of benefits between w, c_y , and the x_1 s.

For the simple case of a firm with only one employee, the problem would be to:

$$\text{maximize } P = F(1-y, y, x_1, \dots, x_n) - (1-y)w - \sum p_i c_i - p_y c_y - Ay$$

$$\text{subject to } U(w, c_y, x_1, \dots, x_n) = U^0.$$

To illustrate clearly the point that we want to make, we simplify the production function to $F(L)$, and consequently also $(1-y)w$ to w . In addition, we suppress the term Ay .

In general, there will be a tendency towards a solution of the following form:

$$\frac{\partial U}{\partial w} = \frac{\frac{\partial U}{\partial c_y}}{p_y} = \frac{\frac{\partial U}{\partial x_i} \frac{dx_i}{dc_i}}{p_i}$$

We see that the employer would tend to distribute his expenditures in such a way that the marginal utility for the employee of one (the last) unit of expenditure is equalized between different items (wage, risk reduction, and other WE and non-WE expenditures). In the analysis to follow, we will restrict our discussion to the WE, and leave aside the other x_i s.

This framework carries with it an implicit assumption regarding the shifting of costs between employer and employee. Exogenously induced changes in one of the variables w , c_y or c_i will cause the others to change and leave the utility of the employee unaffected. For example, the cost of a WE regulation will be shifted to the employee to the extent that it is valued by him/her. Obviously if the above equality held before the change, the exogenous shock would lead to a suboptimal composition of the employment contract. (With an identical use of resources, the utility of both employer and employee could be increased.)

Since the product price is given, it is also assumed that these costs are not shifted to consumers/buyers. To the extent that costs are shifted forward, profits and/or employee utility may increase.

There are at least three qualifications to be made to the above argument. First, to change any of the components in the contract will take time (highly variable for different items). What happens during the transition period may be of great importance. Secondly, we emphasize that the above equality should not be taken literally; it represents a tendency that we would expect to find in employment contracts. In addition, we assumed above that there is certain scope for negotiations regarding the return to capital and the remuneration of employees. Thirdly, this cost-shifting argument concerns changes which affect specific firms. It does not necessarily carry over to the case where all employment contracts in the economy are exogenously affected in the same way, as, for example, by a payroll tax. (However the composition of the contracts would still change.) The utility derived from different employments could then still be the same without cost-shifting.

Our basic assumption regarding payroll taxes is that in the long run these are totally shifted to employees. Holmlund (1983) presents evidence that in the short run, shifting to employees is incomplete, but also notes that "There are several conceivable mechanisms that might prevent an ongoing fall in the profit share." (Ibid., p. 10.)⁶⁶ However, we will also note the implications of a less than total shift of payroll taxes when the nature of the shift is of significant importance.

Finally, we note that as soon as there are two or more employees, additional problems appear. One is the fact that several WE factors are (local) public goods. This creates well-known problems as soon as more than one agent is affected. A natural solution to this problem is for workers to join together in negotiations with the employer. Another difficulty is that it soon becomes impossible (prohibitively costly) to draw up an individual contract for each employee once their number starts to increase. Since individuals differ, this means that a balance must be struck between the preferences of different employees.⁶⁷ However, we would still expect the composition of the employment contract to reflect the same tendency as above towards equalization of marginal utility of the last unit of expenditure on different items.

For future reference, we note that WE regulation would appear as an additional constraint. Specifying maximum levels for the unpleasant WE conditions and minimum levels for the pleasant ones:

$$c_y \geq h_y$$

$$x_i \leq h_i, \quad 1 \leq i \leq l,$$

$$x_i \geq g_i, \quad l+1 \leq i \leq k,$$

where c_y is the required prevention level such as a standard for carcinogens, h_i is the maximum tolerable level of some other negatively valued WE characteristic, and where g_i is the minimum tolerable level of some positively valued one, such as the supply of washing facilities.

The shadow price of the constraints then signifies the costs to the firm of the regulations. Naturally, the case of a shadow price of zero (the constraint not binding) cannot be ruled out (see further Chapter 3).

1.4 Plan of the Study

Basically, there are three possible reasons for a "benevolent government" to intervene with WE policy (Jönsson and Lyttkens, 1981). There can be a deficiency in research, in information, or in decision-making.

In the first case, we lack the relevant information. The possibility that one calls to mind most easily is perhaps inadequate knowledge about occupational health risks, but in principle the same argument applies equally well to positive factors in the WE (and so forth). Since there is an infinite amount of information to be gained from increases in research, the concept must be restricted to situations where the relevant information would have been available, had research not been relatively undersupplied. Our discussion is conducted in terms of a single country. This means that research conducted in other countries can also be of use, provided that we know of it. Therefore, we could also interpret this phenomenon more generally as a deficiency in information production.

This is of course recognized as a typical case of a good with positive externalities that tends to be produced in insufficient quantities. An important part of the WE information is in fact most properly viewed as a case of a public good, i.e., the positive externalities reach the extreme of jointness of supply and non-excludability. This is true of research in general, but especially of the area under discussion, where patent laws etc. are of little use in helping the researcher to

reep the full benefits of the discoveries made. Thus, we have here the usual case for collective funding/subsidies.

The second possibility is that the information exists within the country, but that it does not reach the right persons. In this case, we have a deficient spread of information. In principle, there are two ways to solve this problem. The first is to let a collectively financed body take care of it. The other way is to encourage those who should have the information to come and get it. In other words, incentives are provided in order that it becomes more costly to remain ignorant than to seek out the information.

Thirdly, it may be the case that the right persons have (more or less) the information they should have, but still make the wrong decisions.⁶⁸ Not surprisingly, this is the problem with which economic analysis in this field is usually concerned.

All three points are subject to WE policy in Sweden. Examples of all three points can be found among the policy measures that have been selected for analysis.

The first two sets of measures to be analyzed can be seen as falling under the last heading. (Provided that we take the "benevolent dictator" view of government actions.) As mentioned earlier, we view the WE as one aspect of the employment contract. The analysis begins in Chapter 2 with the Social Insurance system. This represents perhaps the most direct intervention in the labour market contract, and it is therefore a convenient starting point. The most salient aspect of the physical shaping of the WE is the occurrence of occupational injuries. To insure against these events is of prime importance for individuals. This "need" is taken care of by the compulsory Work Injury Insurance. At the same time, we will assume that companies must compensate their employees for running risks of being injured (possibly partly by insuring them). The existence of the Social Insurance system thus implies that company costs for maintaining a hazardous WE is decreased. Consequently, the existence of Work Injury Insurance and Health Insurance alters the composition of the employment contract and changes company incentives with respect to decisions on the WE.

We then turn to WE regulations and the use of economic incentives in Chapter 3. Both of these are geared directly towards the WE decisions. The Swedish Work Environment Act (together with supporting legislation) is probably commonly viewed as the most important WE policy measure. This Act contains stipulations regarding the shaping of the WE, as well as the contacts between employer and employees. However, it is a rather delicate task to describe its effects. As we shall see, several interpretations are possible.

An obvious alternative to regulations is usually the use of "economic incentives": taxes and/or subsidies. We will briefly discuss their applicability to the WE generally. We will then review the Swedish experience regarding the subsidization of WE investments.

The information possessed by the decision-maker is of fundamental importance for the shaping of the WE. An important part of WE policy is represented by the financing of research and information activities. This is the subject of analysis in Chapter 4.

From our earlier discussion of reasons for intervention it would appear logical to treat research and information activities first instead of last. However, there is a good reason for the present course. In order to place a further limitation on our analysis, and because it is inconceivable for the government not to support any WE research, we assume in the rest of the study that decision-makers are as well-informed as it is socially desirable for them to be (not to be confused with "perfectly" informed). We investigate the conditions necessary for this to hold.

The different approach adopted for this policy area makes it convenient to postpone the analysis until the end of the discussion. What is needed in terms of research and information policy is namely not invariant to the other WE policy measures.

In general, public support for research makes good sense, since this activity has public good properties, so that collective action can increase social welfare. However, the WE is but one of many objects of research, and will presumably always get a share of unspecified government funded research. Our analysis is therefore restricted to the question whether specific additional resources for research should be allocated to this research area. We then discuss if particular

measures should be taken to gather and spread the already produced WE information.

So far, we have taken the institutional setting as given. It is important to note that a number of the factors thus treated as exogenous will in fact have a non-negligible impact on the WE. In this and other ways they interact with the WE policy proper. When we have concluded our discussion of the different measures that belong to the latter category, we therefore briefly discuss some of the major exogenous factors in Chapter 5.

Special attention will be paid to the personal income tax and the payroll tax. It is obvious that these taxes are of great interest in connection with the WE. The positive aspects of the WE (and reductions in negative aspects) are alternative and often non-taxable means of remunerating employees, and the negative aspects command higher wages or other compensation. Not only is the tax policy therefore an important determinant of the WE, it also influences the resource allocation between firms and industries.

Any evaluation of WE policy would have to consider such intervening factors. All effects derived above regarding the effects of WE policy are qualitative in character. If we want to discern the absolute effects of government policy on the WE, then non-WE policy must also be taken into account.

In Chapter 6, we make certain suggestions in the area of policy evaluation. We begin by summarizing the effects of our WE policy measures. The desirability of these effects is then discussed in the light of the implications of Swedish tax policy. Some alternative policy measures are also noted. We must emphasize that the ambition of this exercise is very modest. It is not an evaluation in any strict sense. The results should rather be taken to indicate fruitful areas of future research.

In the latter part of Chapter 6, two alternative perspectives are introduced. First the assumption of a purely individualistic welfare concept is relaxed. Secondly, we discuss an alternative principle for government decisions regarding risk of death. Elsewhere in the study, the conventional approach is used. Namely, that government decisions regarding the risk of death should be based on the preferences of

individuals at the time of the decision. This implies that a "statistical life" should be valued differently than the life of a known person in acute danger. We study the implications for WE policy of treating these cases on an equal basis.

Notes to Chapter 1

1. The nature of the employment contract has been subject to much analysis from Adam Smith (1776) onwards. The implicit and multidimensional aspects of employment contracts were further developed by Simon (1957) and Tinbergen (1956). An overview of the theory of the structure of modern corporations is found in Williamson (1981).

Building on the work by Azariadis (1975) and Baily (1974), implicit contract theory has expanded considerably during the 80s. We will later refer to the contributions by Bull (1983) and Holmström (1981, 1983).

2. Our attention is still confined to the physical aspects of the WE.

3. Causes of Death 1981.

4. These problems are most pertinent when one uses interview material to discuss changes in the WE. See n. 12 for some references.

5. In 1976, 3,124 occupational diseases were registered. The 1979 figure was 20,256. This increase was largely caused by the changed definition of occupational disease. Under the new Act, this concept includes all diseases that are due to harmful influences at work (cf. Grönwall and Hessmark (1981), pp. 49-54). The only exception concerns infectious diseases.

6. On one hand, our knowledge of the medical relationships is continuously increasing. On the other hand, the legal practice is changing over time. (Note the vagueness of the definition, n. 5 above.)

7. Up to 1954 occupational diseases are included. However there were few diseases registered during that period.

8. The classifications of the statistical material do not allow us to make a consistent comparison for the industrial sector for earlier periods.

9. See n. 8.

10. Note that the severity rate will be influenced by changes in medical practice and knowledge.

11. Occupational Injuries 1980, Table 2, pp. 111-120.

12. See, for example, the discussion in Living Conditions. Report no. 32. Working Environment 1979, pp. 25-33; also Bolinder et al. (1981), pp. 174-75, and Jönsson and Lyttkens (1981), p. 26.

13. See Bolinder et al. (1981), and Living Conditions. Report no. 32. Working Environment 1979 (especially pp. 10-13).
 14. There are some indirect indicators, such as: the question on personal satisfaction from work (Living Conditions. Report no. 32. Working Environment 1979, pp. 122-124, 171-175), and the question on the existence of psycho-social problems from "other causes" (Bolinder et al. (1981), p. 113).
 15. For example, organization of work is important. This is reflected in questions such as: "Can you influence the choice of your fellow workers?", posed in the surveys on living conditions (Living Conditions. Report no. 32. Working Environment 1979, pp. 111, 166-170). See also Bolinder et al. (1981), pp. 28-32.
 16. See, for example, Eriksen and Qvigstad (1978), Ferraz-Nunes (1982), Jönsson and Lyttkens (1981, ch. 2 and 4), and Moberg et al. (1982).
 17. See, for example, Dahlberg and Grenninger (1974, ch. 2), Jönsson and Lyttkens (1981, ch. 3), and Moberg et al. (1982).
 18. See, for example, Catalano (1979), Dahlberg and Grenninger (1974, ch. 2), Jönsson and Lyttkens (1981, ch. 4), Kossoris (1938, 1943), Moberg et al. (1982), Smith (1976, app. A), Viscusi (1979b).
 19. For a discussion of such factors, see for example Chelius (1977, pp. 12-15) and Risa (1982).
 20. See, for example, "Arbetsmiljön och arbetsvetenskapen," p. 8, or Om statligt stöd till arbetsmiljöinvesteringar, p. 9.
 21. Our concentration on the physical aspects of the WE should naturally not be taken to imply that this is necessarily the "most important" WE area. I would argue, however, that it carries enough weight to merit this investigation.
- In addition, there is a mutual dependence between different WE areas. There are psycho-social aspects of the physical shaping of the WE; solutions of psycho-social issues (such as organization of work) may affect the impact of the physical shaping; and so forth.
22. This is perhaps best exemplified by the Swedish Work Environment Act. It is stated there that the WE should be adapted to human conditions (AML, 2nd ch. 1st section). This applies without qualifications. In the reasons given for the Act, it is made clear that psycho-social aspects of work should also be considered part of the WE (Gullberg, Rundqvist and Starland, 1983, p. 50).
 23. The structure of evaluation studies is extensively discussed in the reports from the MURA project. See for example Nilstun et al. (1982). Lundberg (1982) is an example of an implementation study from the WE area (the Swedish Work Environment Act).
 24. I have corrected a printer's error; the original text reads "that" instead of "then".

25. The case for structurally oriented analysis is further discussed extensively in Ahonen (1983).

26. For examples of benefit-cost studies of WE regulations, see Lindeneg (1984, chapters 16-17), Lundqvist and Springfeldt (1981), and Smith (1976, ch. 3).

See also Om statligt stöd till arbetsmiljöinvesteringar, Bilaga 5 (Dahlberg, A. and Engstrand, G.), on the economics of a WE investment.

27. In addition, there are total cost studies using a different cost concept - Bättre arbetsmiljö (SOU 1972:86) and Springfeldt (1972).

For some international references on cost studies, see Dahlberg and Grenninger (1974) and Ahonen (1981).

28. See the references under respectively Edlund, Moberg, and Nilstun.

29. Cf. Chapter 2, n. 1, and Viscusi (1980a).

30. See Ashford et al. (1980) for an example of a more extensive approach.

31. There is a mutual influence between work and leisure (Ahonen, 1983, pp. 116, 185-186). However, we will confine our discussion to the effects originating at work. In practice both our objective and our subjective experience of the WE is influenced by leisure time activities. This will not be discussed. (For example, the HI is also likely to influence our behaviour away from work. This will have an impact on our health status, which will in turn have effects in the WE field.)

32. Another reason for including this issue is that it is an often discussed aspect of workers' compensation systems (cf. Chapter 2).

33. For macro applications, see the references given in notes 16-18.

34. This should not be taken to imply that, for example, a situation totally without social insurance and WE regulation is conceivable. In fact, it is probably not, as we shall see. Nevertheless, the clear cut case presents the best starting point for the analysis.

35. Nordfors (1985, ch. 2) argues that this potential was predominant in trade union thinking in the early sixties.

36. In addition to the AML, measures such as the Act on the Joint Regulation of Working Life (Lagen om medbestämmande i arbetslivet, MBL) are of importance in this respect.

37. The general implications of dynamic vs. myopic strategies for employees' job choice is extensively investigated in Viscusi (1979a).

38. See n. 1.

39. See further Rosen (1974); also for example Lucas (1977), Smith (1979a), and Thaler and Rosen (1975).

This is not to say that the markets for WE quality are "perfect". Incompleteness of these markets help to explain the existence and long-term nature of "implicit labour market contracts" (Bull, 1983).

40. However if consideration is only given to production and its distribution, this is not, theoretically, an efficient form of wage payment (Söderström, 1981). The fact that wage payments based on output are unusual either implies that they are unpleasant in themselves (cf. Chapter 2, n. 9), or that they adversely affect employee behaviour. (In the latter case, merit wants or difficulties in controlling fellow employees are implied.)

41. Utility functions that depend on the state of the world have been used in the WE context by a number of authors. For example, Diamond (1977), Rea (1981), and Viscusi (1979a,b; 1980a).

42. The uncertainty about future states of the world also concerns non-work time and issues. What happens "outside" the workplace will often influence individuals' valuation of the WE. However, we do not deal with this aspect in our study, as mentioned above (n. 31).

43. Viscusi (1979a, p. 11; 1979b; 1980a; 1983b, p. 89) explicitly and Rea (1981) implicitly assume that an injury lowers the marginal utility of money. Diamond (1977, p. 71), on the other hand, suggests in passing that the opposite may hold. Those working in the tradition where an injury is modelled as a reduction in wealth in effect also assume that the individual has a higher marginal utility of income when in ill health. Examples in the WE area of this approach include Oi (1973, 1974) and Thaler and Rosen (1975).

44. The incentives approach is given additional appeal by these considerations. It is not possible to determine how different individuals value occupational hazards, without detailed investigations into individual circumstances.

45. It is well-known that otherwise risk-averse individuals may become risk-takers in certain situations, e.g. when gambling.

46. We do not make the distinction suggested by Diamond (1977, pp. 75-76) between perception and valuation of risk.

47. Trade union representation may even in some circumstances lead to an over-estimation of these risks, cf. section 5.4.

48. Marginal workers may have a tendency to overestimate average risks, because, to the extent that they are newly hired, they face an above average risk (Smith, 1976, p. 31).

At the same time, the preferences of younger workers may vary in a systematical way from those of older workers. This is investigated in Viscusi (1979a, ch. 3). See also Viscusi (1980b).

49. See, for example, Diamond (1977), and Akerlof and Dickens (1982). In addition, Viscusi (1979a, ch. 4) has shown that workers may prefer risky jobs in the absence of under-estimation of risks (cf. n. 55).

50. As noted by Diamond (1977, p.79) the joint distribution of perceptions and skills should be modelled here. The argument as presented assumes that these distributions are independent.

51. Akerlof and Dickens (1982) translate this psychological theory into "economic language" in the following way:

1. Persons not only have preferences over states of the world, but also over their beliefs about the state of the world.
2. Persons have some control over their beliefs. They can manipulate their own beliefs by selecting sources of information likely to confirm "desired" beliefs.
3. Beliefs once chosen persist over time.

For a fuller presentation the reader is referred to the article by Akerlof and Dickens.

52. For an analysis of workers' acquisition of information prior to employment, see Viscusi (1979a, section 4.5).

53. Viscusi has noted that the average injury risk for American workers is substantial, exceeding 1/30 (Viscusi, 1983b, p. 77). We can get a comparable figure for Sweden by dividing total hours worked in 1979 by 1,800 (i.e., assuming that everybody works full time), and then dividing the number of occupational accidents by the resulting figure. In the whole economy, every 25th worker met with an accident (assuming that nobody had more than one accident). In the most dangerous industries accidents were 3-4 times as common.

Thus risks are clearly observable. (The employee will also be aware of many injuries befalling fellow workers.) However, this does not necessarily imply that risk estimates become more correct. (The empirical material in Viscusi (1979a, ch. 14) is inconclusive.) Diamond states that "Given the low probability of occurrence of many of these risks, there will be no significant improvement in the rules of thumb [to determine the risk for an individual] as a consequence of individual experience within a single lifetime." (Diamond, 1977, p. 75 n. 17.)

In fact, the psychology of learning may be such that on-the-job experience produces an under-estimation of risks (Leyman, 1982, pp. 44-46).

54. Cf. Bolinder et al. (1981), p. 177, who note this as one possible explanation for the fact that safety stewards are more apt than ordinary employees to consider the WE to have improved.

55. In his model, this holds even if workers learn about their risks through on-the-job experience.

See also Viscusi (1979a, ch. 4) where it is shown that in addition to the under-estimation of risks (and independently of such aspects), workers may tend to choose jobs with uncertain and higher risk probabilities. Cf. Chapter 3, n. 37.

56. Viscusi (1983b) goes so far as to suggest that "... there appears to be little support for a general presumption that workers typically underestimate risks, but this possibility should be considered within the context of the specific type of hazard." (Op. cit., p. 77.)

57. Questions concerning the relation between capital intensity of production and the WE are consistently left out of the picture in this study.

58. In Sweden, "occupational injuries" according to the official definitions also include accidents occurring on the way to or from a workplace (commuting accidents). These are not included in our study, since they bear only a weak connection with the WE.

59. The importance of labour turn-over (as a function of job hazards) for employer behaviour is thoroughly discussed in Viscusi (1979a, chapters 7, 8 and 10). Empirically the relation between job hazards and worker quit rates is also investigated (op. cit., chapters 13 and 16).

60. This can easily be transformed to accident cost per typical injury and similar measures.

61. The case of a cost-minimizing firm is discussed in Appendix 1.

62. Ashford et al. (1980, p. 91) argues that a firm is risk-averse with respect to "substantial risk".

63. The captive system would then only imply that some companies are large enough to have one division specializing in settling contract disputes.

64. Normally, we want to place risks on risk-neutral agents. Therefore, if companies are risk-neutral, they should ceteris paribus carry risks. To the extent that this will place individual decision-makers within the firm under risk, this implies a welfare loss. The risk in this case can take the form of being given less interesting assignments, or not being promoted to more interesting ones. However, this type of risk must be compensated ex ante (cf. the discussion in section 2.1), and the individual can buy an insurance against it. This mitigates the welfare loss. Moreover, it will often be socially desirable that decision-makers within firms carry some risks. This follows from the moral hazard effect that would be present with complete insurance. In this case it would presumably be of considerable importance for the performance of the insured. Henceforth, the welfare effects for decision-makers within companies will not be considered in the analysis.

65. For a one man firm, the problem changes to one of utility maximization with the expression for profits as a constraint. The $(L-y)w$ term disappears, since the wage is included in the profit. With the simplification used below - that is, with the production function as $F(L)$ - the first order conditions of the Lagrangian yields:

$$\frac{\partial U}{\partial P} = \frac{\frac{\partial U}{\partial c}}{p_y} = \frac{\frac{\partial U}{\partial x_i} \frac{dx_i}{dc_i}}{p_i}$$

66. The material in Normann (1983) is inconclusive, though he draws the conclusion that there is almost no shifting to employees (Hansson, 1984). See also Söderström (1985) on the limitations on the state of the arts on this issue.

67. Both these issues are discussed in Chapter 5. See also Appendix 1.

68. As noted by Ahonen (1983), these "... decision-making problems include a lot of objective - as opposed to subjective - informational elements (e.g. the price mechanism)." (Op. cit., p. 68 n. 7.)

2 COMPENSATION FOR NEGATIVELY VALUED WORK ENVIRONMENT CHARACTERISTICS

We argued in Chapter 1 that the WE can be seen as one part of the labour market contract. Given that framework, one aspect that is of fundamental importance is the manner in which the employee is compensated for negatively valued WE characteristics. A salient feature of the WE is the occurrence of occupational injuries. It is a cardinal principle of Swedish policy that the victim of an occupational injury should be quickly and adequately compensated. Such compensation is now provided by (compulsory) Social Insurances - the Work Injury Insurance and the Health Insurance.

In this chapter we will study the effects of the policy measures pertaining to the compensation issue. The following are the main conclusions from this analysis:

The Social Insurance system favours industries and firms with a relatively large number of occupational injuries and high sickness absenteeism; resources will move to these activities/firms.

Injury prevention within firms will decrease, both in the short run and in the long run technological development, because of the Social Insurance system. The same holds, *mutatis mutandis*, for expenditure to decrease sickness absenteeism.

Large groups of individuals are overinsured with respect to sickness absenteeism, and possibly also for minor occupational injuries. This implies a welfare loss for them to the extent that they pay for this part of the coverage.

It has become easier for accident prone and (especially) sickly persons to find employment.

In general, we would expect a tendency for the employees to be compensated for negatively valued WE characteristics, and *vice versa*.¹ This compensation may take a variety of forms - pecuniary and non-pecuniary - including positively valued WE characteristics. The decisions of both firms and employees are affected by this policy

since the Social Insurance system provides some of this compensation (mainly for pecuniary losses). The influence on the incentives of both parties with respect to prevention of losses will be studied as well as the welfare implications of insuring presumably risk-averse individuals. In addition, we note the effects on resource allocation that result from the particular financial arrangements used for the insurance system.

There is an additional reason for using this as a starting point for the analysis: namely, that the policy enacted in this area has major repercussions for the other fields of WE policy.

We have assumed that an employer cannot offer lower net benefits than other employers, ceteris paribus. Thus, workers that are subject to a low quality WE would receive compensation. The compensation can be pecuniary or non-pecuniary. In the latter case, it may consist of positively valued WE characteristics or of less negatively valued ones.

It is important to note that it is the "net" disutility that will be compensated. This is extensively discussed by Komesar (1974) in relation to "personal injury loss". He makes several important observations. Notably, that loss of non-market time should be compensated; that "... pain and suffering [...] is a component of loss potentially associated with all 168 hours of the week." (ibid., p. 478); and that compensating total income loss (market time) may imply over-compensation as far as utility levels are concerned, if the time is instead used at home to increase utility.

In a frictionless world, this compensation would ensure that an efficient amount of resources is allocated to WE improvements. Employees would get the WE they desired. The WE would be improved as long as the marginal (social) benefit of the improvement exceeds the marginal (social) cost. This is a well-known result. In addition, the company will choose the correct activity level/production volume (Shavell (1980b), cf. below), and the total production within the industry will be correctly determined (Polinsky (1980), cf. below). Without providing a formal proof, Diamond (1977) noted that "Demanders [...] must equate the marginal value of the commodity demanded to the marginal social cost of production, including costs of accidents. This will give the correct aggregate demand." (Diamond, 1977, p. 69.)

At the same time, individuals would seek employment in accordance with their personal characteristics and preferences. The allocation of workers to different jobs should - to be efficient - correctly reflect their preferences and skills. For example, it should reflect both the comparative advantage in dealing with risks, and their relative aversion to risk. (Cf. Diamond, 1977, pp. 69, 81-83; Viscusi, 1983b, pp. 132-135.)

In such a world, where everybody has full information and there are no transaction costs, different modes of compensation will produce the same resource allocation.² This follows from the logic of Coase. Government decisions on property rights and liability rules may change the distribution of income (and wealth), but not resource allocation.

Of course it is precisely because there are transaction costs and nobody has perfect information that the choices in these respects are of importance (for resource allocation). However, we must emphasize again that we are dealing with a contractual relationship. This implies that the transaction costs for dealings between the parties are lower than otherwise. For example, this sets the WE distinctly apart from the natural environment (Ståhl, 1972; Chelius, 1977, p. 8).³ The usual case of externalities is not present.⁴ On the contrary, as emphasized for example by Skogh (1982), Ståhl (1972), and Veljanovski (1982a), negotiations will internalize many effects. In principle, everything can be specified in the contract. If something is left out of it, either due to deliberate choice or lack of information, the reason must be explicitly explained. These aspects must be given repeated consideration when we discuss the effects of public policy.

However there are also transaction costs in the contractual relationship. Chelius (1976) has shown that government decisions on the provision of compensation may affect resource allocation. (Notably, the introduction of mandatory workers' compensation insurance in the first half of the 20th century.)

This brings us to the following question: "To what extent will compensation actually be forthcoming?" The one area where this question has been extensively examined is in the field of wage differentials. The results from these numerous studies lend support to our hypothesis. Smith (1979a) provides a summary of the studies up to 1978. The hypothesis has been subsequently examined by, for example, Brown (1980), Dickens (1984), Duncan and Holmlund (1983), Duncan and Stafford (1980), Leigh (1981), Olson (1981), Pedersen (1982), and Viscusi (1980b). Söderström (1980) analyzes the important distinction between compensatory and "non-compensatory" differences. (Most factors causing non-compensatory differences will work through the wage structure.) All in all, the evidence for the existence of compensating wage differentials, while not being overwhelming,⁶ is still pretty convincing. We may note that this also pertains to situations where WE regulations and public insurances are present.

The conclusion that I would like to draw from these studies is the following: compensating wage differentials can arise in a market-type economy. Neither workers' ignorance nor transaction costs are sufficiently large to eliminate them in the countries studied. However, it does not automatically follow that we should expect such differentials in Sweden. The investigations of Pedersen (1982), and Duncan and Holmlund (1983) are therefore of particular interest. The former concerns Denmark, the latter Sweden.

Drawing international comparisons in the WE field is a precarious undertaking.⁷ There are many intervening factors. The extent to which there are compensating wage differentials will also depend for instance on the regulations in the WE area. It is difficult to determine if these lead to a greater reduction in the need for compensation in one country than in another. Nevertheless, the fact that Pedersen (1982) has found some evidence for the existence of compensating wage differentials in Denmark implies in my view that we can expect such differentials to also exist in Sweden. This lends some support to the findings of the one Swedish study on this topic. Duncan and Holmlund (1983) found compensating wage differentials of the magnitude of 2-4% in the early seventies in Sweden.⁸ It seems reasonable to use them as a first indication of the magnitude of the wage differentials that might be found. It must be emphasized that the material refers to the period 1968-74; that is, before the enactment of much of present day WE regulations.

We will now proceed on the assumption that compensation for negatively valued WE characteristics is an integral part of the labour market contract. However, our argument should never be taken to imply that compensation is in any sense perfect. What we do assume is that there are tendencies in the direction that follows from the theoretical argument. This still leaves scope for effects on resource allocation of government decisions on how compensation should be provided. (This is particularly the case when employees underestimate occupational risks and consequently demand less compensation for these risks (Diamond, 1977; Veljanovski, 1982a).) Such policy measures are also important for another reason. The bearing of risk must be considered, since individuals are risk-averse. As emphasized by Shavell (1979a) the welfare implications of different systems cannot be discussed without incorporating this aspect.

We will now first discuss the general problem in section 2.1. This is the question of how compensation for negatively valued WE components could be provided. This compensation can either take an ex ante form, such as wage differentials, or an ex post form, such as insurance. In the latter case it is possible to take account of the state of the world that has occurred (cf. below). In section 2.1, we will discuss the choice between ex ante and ex post compensation.

The relevant parts of Swedish WE policy will then be discussed in section 2.2. These consist of compensation for pecuniary losses administered in the form of Social Insurances - the Work Injury Insurance and the Health Insurance. Coverage is in most cases almost complete. As liability claims can be made for occupational injuries, we also include a brief description of this aspect of Swedish law on torts. The compensation of other negatively valued WE characteristics is not treated as a policy issue. It is instead left to labour market negotiations, and the possibility of appeal to the law on torts.

The two Social Insurances are discussed in section 2.3. We shall also see that WE regulations may be viewed as a natural (though not the only possible) complement to these measures. Some of the effects of this regulation can conveniently be analyzed with the same tools.

Finally, in section 2.4, we make some comments on the privately formed insurances that complement the Social Insurance system.

2.1 The Provision of Compensation

First we note the (obvious) fact that the labour market contract must be entered into ex ante; that is, before the future states of the world are known. Compensation, on the other hand, can be determined either ex ante or ex post. For purposes of simplicity we shall call these modes ex ante and ex post compensation. The advantage with the latter is that it has a potential to eliminate uncertainty.⁹ The claims of the employee can then be made contingent on which state of the world occurs. S/he bears less risk. Thus, risk-averse individuals will prefer ex post compensation ceteris paribus. The decrease in risk

is also per se beneficial for the individual, cf. below.

With ex ante compensation, all fluctuations due to the occurrence of a particular state of the world will fall on the individual. Specifically, if s/he meets with an accident, and thus cannot work, s/he will receive nothing from the company. Ex post compensation, on the other hand, is contingent upon the state of the world. In the no-accident case, the individual can then accept a lower payment in order to be paid relatively more when an accident occurs (and the individual consequently does not work).

Ex post contractual compensation in effect means that the company insures the employee. Consider first the distribution of pecuniary benefits between different states of the world. Diamond (1977) has shown that risk-averse individuals who maximize expected utility would want to equate the marginal utility of wealth between the state of having an occupational accident and the state of remaining non-injured.¹⁰ Furthermore, he has shown that this is precisely the distribution of the ex post compensation that will be provided by the employer, under ideal conditions. On the other hand, when workers underestimate risks, the benefits paid in the case of injury will be too small (as will wage differentials).

The choice between contractual ex ante and ex post compensation is influenced by a number of factors. Most of these relate to the transaction costs involved.

For both kinds of compensation, the parties must identify all possible states of the world. In addition to eliminating uncertainty, ex post compensation makes it unnecessary to discuss the probability of different states of the world. This is needed for ex ante compensation. On the other hand, there are two costs that are specific to ex post compensation. These are the cost of specifying in the contract a compensation for each state of the world, and the cost of ascertaining (and agreeing upon) which state of the world actually has occurred.

We also note that publicly enforced specific liability rules - a form of ex post compensation - give rise to the same contractual costs as ex ante contractual compensation. The likelihood and nature of different states of the world must be investigated. In addition, some idea must be obtained regarding the probable size of damages to be awarded by courts. The same is true for the ordinary law on torts.

The WE disutility that is to be compensated can take different forms. The actual form has implications for the kind of compensation to be chosen. The disutility can be pecuniary or non-pecuniary, temporary or permanent. This gives us four kinds of disutility. Naturally, in many cases the disutility will be of more than one kind. For example, an occupational injury will usually entail both pain (non-pecuniary) and loss of income (pecuniary).

It is prohibitively costly to make the employment contract individualized. This means that both ex ante and ex post compensation will have to be standardized. For the present discussion, the important implication is that ex post compensation cannot eliminate uncertainty. Unless, of course, a certain state of the world brings the same disutility to everyone, or a disutility that needs the same compensation. Thus ex post compensation is most valuable in cases, which have, in this sense, an equal disutility for a given state of the world. The obvious (and only) example is pecuniary losses. Although these do not give everyone the same disutility, they do require the same amount of compensation to eliminate the utility loss.

Of course, it cannot be concluded that ex post compensation will not increase individual welfare since it is unable to eliminate uncertainty. It may well be that the reduction in uncertainty that it does produce is worth its cost.

Ex post compensation is less expensive if the state of the world can be easily identified. This makes it relatively easy to compensate ex post for certain pecuniary losses, particularly those due to occupational accidents and sickness absenteeism. On the other hand, with chronic occupational diseases, it is often difficult to ascertain the state of the world with which we are confronted (that is, if it is indeed an occupational disease).

It is generally more difficult to provide ex post compensation for non-pecuniary disutility. Take for example the non-pecuniary aspects of occupational injuries; or the so-called psycho-social WE characteristics. Here ex post compensation cannot eliminate uncertainty, since disutility will be highly individualistic. In addition, disagreement about the state of the world is to be expected. For the psycho-social factors however, this is less serious. It seems reasonable to assume that they are less dependent on the state of the world. The uncertainty concerning these factors will be less than for many others. At least after the employer-employee relationship has existed for a while. This makes ex post compensation less necessary (or less valuable).

A special case is provided by those conditions that reduce the marginal utility of money to zero, for example, the case of fatal occupational injuries. There is no point in transferring wealth (or any other benefits) to these states of the world. Hence it is assumed that the contract will entail ex ante compensation for these kinds of risks. Note that any bequest motive can be provided for by resorting to the insurance market.

The existence of the insurance market must be considered repeatedly in our analysis, since it has implications for many of our problems. Here, we note that any (pecuniary) ex ante compensation could be transferred by the individual to ex post compensation by privately buying an insurance. However, this solution will probably only be chosen by an individual who is considerably more risk-averse than

average or possibly in the case of large losses. (If it was simple (cheap) to provide ex post compensation, the employer would have done it, either by himself or through the purchase of insurances on behalf of the individual.)

The producing firm as a middleman has some advantages compared with a direct contract between individual employees and an insurance company. It knows more about the environment where the employee works, and it can more easily monitor his/her behaviour. In other words, the amount of losses to be compensated is influenced by company and employee decisions, both of which can be more easily checked by the producer than by the insurance company. (This reduces the problems with moral hazard and adverse selection.)

The advantages of the insurance company are based in risk pooling, risk spreading, and specialization. However, the producer as insurer will normally be able to re-insure, which eliminates the former two advantages. (This is important, for instance because the probabilities of occupational injuries are not independent. An accident may involve more than one employee, a number of employees may contract the same disease, etc.) Specialization works against the employer as insurer. This is particularly important for small firms. Nevertheless, without putting the issue to the "market test", there is no way of knowing which solution, or combination of solutions, will be chosen.¹³

In summary, the company can provide compensation ex ante or ex post. The compensation can be pecuniary or non-pecuniary. The former we denote compensating wage differentials. The latter will include WE improvements.¹⁴ Ex post compensation could take the form that the company buys an insurance for the employee, or that the company acts as insurer. In the latter case the company in its turn may insure itself somehow.

Non-pecuniary disutility will usually be compensated ex ante. (But note the discussion of the TFA in section 2.4.) Specifically, risk of death and severe injury must be compensated ex ante. Loss of income, on the other hand, will normally be compensated ex post.

The government can intervene in the compensation issue in a number of ways. First, it can impose specific liability rules. In the absence of such intervention, the parties can resort to the general law on torts. This legislation then plays an important role. Secondly, part or all of the compensation can be provided by the government. Thirdly, one can specify requirements for the WE, thus changing the grounds for compensation. These are only some examples of what can be done. (The latter two correspond to actual Swedish WE policy.)

As we shall see, the policy measures to be discussed in this chapter only deal with pecuniary compensation. It should be obvious by now, however, that such measures via the employment contract will also affect the provision of other kinds of compensation.

2.2 Swedish Policy Measures Pertaining to the Compensation Issue

Let us now describe the relevant parts of Swedish WE policy. These are the Work Injury Insurance and the Health Insurance. These policy measures concern the compensation for occupational injuries and for sickness absenteeism. The compensation is exclusively pecuniary. Unless otherwise explicitly stated, it is this case we refer to when we talk about compensation in the rest of this chapter. The main focus will be on occupational injuries.

In effect, a substantial part of the compensation for negatively valued WE characteristics is provided by the compulsory public Social Insurances - the Work Injury Insurance (WII) and the Health Insurance (HI). It is obvious that the WII should be the subject of study. One analytical reason for including the HI will be given in the next section. In addition, these two insurances are coordinated (cf. below), so that a considerable part of the compensation paid to the occupationally injured is paid from the HI.¹⁵ We concentrate here on the main features of the WII and the HI.¹⁶

For reasons that will soon be clear, it is convenient to begin with the HI which is approximately 90% financed by a uniform payroll tax of 9.5%.

The HI compensates 90% of loss of income by sickness cash benefits. There is, however, an upper limit. The highest income which affects the size of the benefits is 7.5 times the so called basic amount¹⁷ (which in September 1985 was 21,800 SEK). Loss of that part of the income which exceeds the limit will not be compensated. The sickness cash benefit is paid from the day following the one on which the illness was reported. In other words, there will sometimes be a waiting-day.¹⁸ The benefits are taxable. For shorter periods of illness, the net of tax compensation is almost total for the

representative worker who has a marginal tax rate of around 50%.

Health care is also paid for by the HI and by other public expenditure. The patient pays a very small fee when visiting a doctor, and only some of the costs for pharmaceuticals. For hospital stays, the sickness cash benefits will be reduced by a small amount.

Finally, it should be mentioned that for periods up to one week, the individual alone decides on reporting sickness. After one week, a medical certificate is needed to qualify for the HI.

The WII is also financed by a uniform payroll tax which is at present 0.6%. During the first 90 days, the WII is coordinated with the HI. Occupationally injured persons then receive benefits from the HI as described above. Thereafter the WII compensates 100% of the income loss, up to a maximum of 7.5 times the basic amount. Furthermore, there are no more patient costs for medical care, etc; these are paid by the WII.

If a person's earnings capacity is permanently reduced by an occupational injury, s/he is entitled to a life-annuity from the WII. In principle, this should cover 100% of the income loss. However only that part of the income that does not exceed 7.5 times the basic amount will affect the size of the annuity. It is also important to note that the annuity is determined from the income at the time of the injury. No account is taken of future changes in earnings capacity.¹⁹ As pointed out by Söderström (1983), this has the following strange effect: for young persons in particular, the amount of coverage is normally much greater for temporary than for permanent loss of income.

Finally, life-annuities to survivors are paid out to widows and children (but not to widowers), and in the fatal cases funeral allowances are also paid.

On the other hand, pain and suffering and other such "non-economic" losses are not compensated by the WII (or the HI).

Hence the public ex post compensation for occupational injuries have the following main characteristics. Loss of income up to the prescribed maximum is usually almost fully compensated; above the maximum no compensation is given. Direct expenditures caused by the injury are compensated. Pain and suffering is not compensated, and neither is loss of non-market time.

In addition to these public interventions we must also take into account that the law on torts (based on the Act on Torts (skadeståndslagen)) is applicable to cases of occupational injury.²⁰ We will present some interesting features of the possibility for the injured person to make compensation claims.

A party is liable if an injury has been caused by negligence.²¹ In theory, there exists the possibility of the defence of contributory negligence. In other words, the employer would not be liable if negligence on the part of the employee has contributed to the occurrence of the accident. However, for our purposes, this seems to be of negligible importance. In the case of personal injuries the victim must have been grossly negligent.²² Even in that case the compensation is only decreased - not eliminated.

When a compensation claim is determined, one subtracts the benefits from the WII and the HI.²³ It is important to note, however, that there is no upper limit for the loss of income which can be compensated under the law on torts. This fills that "gap" in the protection offered by the Social Insurance system. In addition, the loss of non-market time, and pain and suffering, can also be compensated.²⁴ But not all "non-economic" losses can be compensated; for instance, neither sorrow nor disappointment.²⁵ Finally, funeral expenditures and the loss of alimonies are compensated in fatal cases. The latter is taken to include the value of household work of the deceased.

Regarding the effect on company decisions of the threat of liability claims, it is important to note that damages paid to victims of occupational injuries are tax deductible. Life-annuities are normally always deductible. Once and for all payments are deductible if the damages may be considered a cost of the business.²⁶ This means that general tax revenue will cover part of the damages.

It should be noted that part of the disutility associated with an occupational injury accrues to members of the victim's family.²⁷ It is reasonable to suppose that information on this disutility can be communicated within the family. Therefore, it can command compensation ex ante. However, it is also possible to compensate for this disutility ex post. In so far as this is done, the need for ex ante compensation is naturally reduced. For example, the payments to survivors that follows from the WII and the Act on Torts reduces the amount of ex ante compensation necessary for death risks. Henceforth, we will not deal with this aspect, but confine our attention to the compensation paid to the potential or actual victim. (The disutility accruing to others can be thought of as one of the negatively valued psycho-social WE characteristics that are to be compensated ex ante.)

We conclude that a great deal of the compensation issues in relation to occupational injuries are dealt with by public policy. Compensation of other negatively valued WE characteristics is left to the labour market negotiations.

2.3 Effects of the Compensation Policy

The most obvious feature of the compensation policy is that the individual company is relieved of that part of the injury costs. Everything paid for by these Social Insurances is financed through uniform payroll taxes.

As noted in Chapter 1, the effects of this public policy are outlined as compared to the no-intervention situation. Our basic assumption here is that a private solution to the compensation issue would not free the individual company of these costs. (At least not to the same degree as the Social Insurance system.)²⁸

With this system, the company can seemingly avoid all accident costs related to the employee and compensatable under the law on torts. This only requires that the company avoids being negligent. Thus these costs would accrue to the employee. However, as noted by Chelius (1974; 1977, p. 34) and Veljanovski (1982a, pp. 269-70), the employees would then demand (additional) compensation. The contractual relationship between employer and employee therefore represents a

different case than the one usually considered in the literature on the economics of liability rules. It can thus be seen that the perspective chosen for this study reduces the importance of the law on torts and other liability rules for WE determination. Without going into detail, we may note two factors that might change this situation. First, if the market does not work, so that less compensation for negatively valued WE characteristics is provided in the employment contract.²⁹ In this case, mandatory compensation, for example liability claims, is what remains. Secondly, the time perspective may be important. Liability claims can vary immediately in response to changes in the WE. Compensating wage differentials and such like will evolve slower.

Similarly it is important that the costs for the two Social Insurances are borne by all employees together, not by the employees in each firm. In the latter case, the labour market negotiations would in principle transfer the costs back to the individual company.

Thus, with two exceptions a particular firm will bear the full costs for the negatively valued WE characteristics.³⁰ The major one is the payments from the WII and the HI. In addition, there is the deductibility of damages. However there is one important qualification to that statement. If we assume that workers underestimate the risk of occupational injuries, the latter will command less compensation. (See also the discussion of "under-compensation" on pp. 97-98.)

Resource Allocation between Industries and Firms

A number of authors who have dealt with accidents and liability rules have pointed to the effects of not imposing the full costs on the individual company. We begin our study with a discussion of two related problems. The total (social) injury costs will depend on both the level chosen for the dangerous activity, and on the market reactions of employers (and employees). Thereafter, we discuss the effects of the method chosen to finance the WII and the HI.

The case of activity levels has been analyzed by Shavell (1980b). The number of injuries and thereby the total accident cost will often depend on the level of the dangerous activity. For example, a company introducing shift-work would "produce" considerably more occupational injuries for the same expenditure on prevention. Thus, the outcome depends on whether firms have to take into account the change in costs implied by the choice of activity level.³¹ If they do not, then they will tend to "produce" more accidents.

From the above, it might be tempting to draw the conclusion that the level of activity should be incorporated in, say, a WE regulation. The effect of WE regulations will be analogous in the present context to the effects of a negligence rule. They specify a desired minimum level for the prevention activity of the firm ($c_y > h_y$).³² Shavell (1980b), notes this possible use of negligence standards. However, he also points to the practical difficulties involved and to the additional problem analyzed by Polinsky (1980). The latter has shown that regulating the activity of individual firms without any consideration of "macro effects" would not be sufficient.³³ In the long run, the number of firms in an industry is variable. With a negligence rule, firms will choose not to be negligent. Thereby, they avoid injury costs. Hence their production becomes less expensive. If the negligence standard is set at the short run efficient value, the following will ensue: too many firms will be attracted to the industry, total production will be too high, the products will be sold at too low a price, and each firm will produce too little. The socially optimal due care standard is then higher than the efficient one.

An over-production of goods that are "risky" to produce would also occur when workers underestimate injury risks (Diamond, 1977). This would also cause excessive employment in high-risk industries (Veljanovski, 1982a).³⁴

The general problem faced in these discussions is how to control two (or more) behavioural variables with only one policy variable. One possible solution would be to supplement a negligence rule with a tax on the activity, as suggested by Shavell (1980b, p. 7, n. 12). Another possibility is, of course, to abandon negligence rules altogether, in favour of other policy measures. In fact, an appropriate tax on the activity would control both behavioural variables (cf. Baumol, 1972).

For the Swedish case, we must add another aspect of the resource allocation issue. As mentioned the WII and the HI are financed by uniform payroll taxes. In other words, there is an implicit transfer from low-risk industries to high-risk ones.³⁵ The greatest reduction in compensation paid to employees will occur in industries that have relatively numerous and/or sizeable occupational hazards. This property of the Swedish WII has been frequently noted.³⁶ (For example by Hansson, Lyttkens and Skogh (1984), Jonsson (1974b), Skogh (1977a,b; 1982), and Springfeldt (1979). Skogh has also pointed to the similar effect of the HI.)

In summary these Social Insurances tend in a number of ways to favour industries that have many occupational injuries and high sickness absenteeism. This conclusion is based on the above assumption that the Social Insurance system reduces the injury costs pertaining to the individual company, as compared to a case of non-intervention. If workers underestimate their occupational hazards, this will also favour high-risk industries.

However, these effects will be counteracted by the impact of WE regulations and income tax. The progressive nature of the latter means that compensating wage differentials will be taxed at an increasing marginal rate. (This is more fully discussed in Chapter 5.) Thus, in practice there is an "indirect tax" on dangerous activities.

Resource Allocation within Firms

We now turn our attention to the prevention activity within the individual firm. In itself, the fact that part of the injury costs are taken out of the employer-employee contract will lead to less prevention activity. In all probability, the prevention activity will decrease in all companies. A variable cost is transferred to a uniform payroll tax.³⁷ Accidents and the contraction of diseases by employees now cost less. This aspect of the Swedish WII has been emphasized by Skogh (1977a,b; 1982) and also noted by Ståhl (1972).³⁸

Even more important than the changed investment incentives is probably the effect on long run technological development. For the same reasons as in day-to-day decisions, priorities in research and development will change in a direction with greater occupational hazards. As argued before, this long run development is a more important determinant of WE quality than ex post facto regulations can ever be. This effect is reinforced by workers' under-estimation of risk (Diamond, 1977).

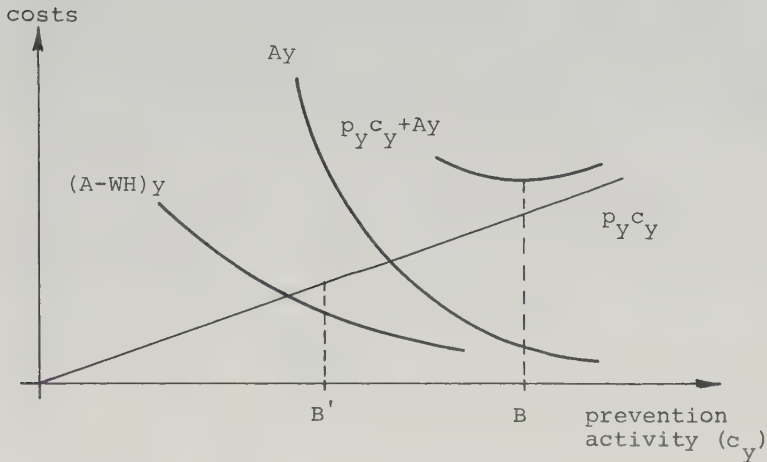
In the absence of the Social Insurance system, the employment contract would contain additional compensation for occupational hazards, and the company would spend more in order to decrease these risks. As prevention decreases, wages and other benefits (including positively valued WE characteristics) will increase, to leave the utility of employees unaffected. Thus, the composition of the employment contract is changed.³⁹

This can be illustrated by a simplified example. (An algebraic proof of a more complex version is given in Appendix 1.) We concentrate here on prevention and direct injury costs, i.e. on the term $(p_y c_y + A_y)$ in the profit maximization where $p_y c_y$ is the prevention cost and A_y is the (expected) injury cost (see section 1.3). We ignore here the effect of injuries on the production process.⁴⁰ The firm will try to minimize the sum of these costs. Prevention will then be carried to the point where marginal benefits equals marginal costs i.e. marginal prevention costs would equal marginal decrease in injury costs.

This situation is illustrated by Figure 2.1. We assume that the marginal benefits of preventive activity (in terms of injury cost reduction) is decreasing. This is a reasonable (and usual) assumption for the range of WE improvements that are relevant. The introduction of the WHI and the HI leads to a reduction in A which we designate WH . It is reasonable to assume that WH lowers and flattens the A_y -curve, as shown in the figure. From this assumption, it immediately follows that there will be less prevention activity. Point B' is chosen instead of point B .

Figure 2.1: Effect of two Social Insurances on prevention activity.

Lower prevention level (B') chosen



Naturally, in Swedish WE policy, the Social Insurance system is not considered as the measure to guide prevention activity. This role is instead played by the AML. In most cases, the implementation of this law takes the form of WE regulations. These regulations can be seen as a hardly surprising consequence of social insurance policy. As part of the incentives for accident prevention have been removed, one tries instead to impose a certain prevention activity upon individual companies.⁴¹ As noted above, the effects of these regulations can be analyzed in terms of negligence rules. A level of injury prevention is specified. If this is not attained, some additional (expected) costs would fall on the firm.⁴² These costs ought to be determined in such a way that the firm complies with the regulation (chooses not to be negligent). (The relationship between alternative ways of inducing the firm to choose an efficient prevention level is investigated by Skogh (1982). We will return to these aspects in Chapter 3.)

The effects of the regulations are influenced by the Social Insurance system. Below, we will use Figure 2.1 as a starting point to analyze these effects. At the same time, some general properties of WE regulations will be noted (anticipating the discussion in the next chapter).

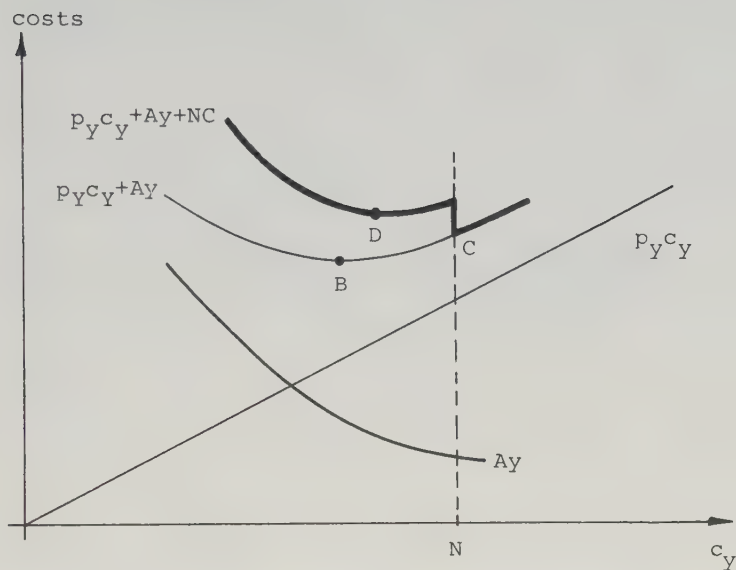
In addition, this framework enables us to show where the law on torts enters the picture.⁴³ The influence of this law stems from the opportunity open to the employee to make compensation claims on his/her employer. These will be awarded when the latter has caused the injury through negligence. The negligence rule that is applied in these cases can - but need not - be the same as the care imposed by the WE regulations. Hellner (1976, p. 79) notes that the ruling of negligence in liability cases will probably be much influenced by WE regulations. Thus, in the case where a company has failed to comply with the regulations, a verdict of negligent behaviour is much more likely.

It was formally shown by Brown (1973) that under certain circumstances a negligence rule could be efficient. However, as discussed for example by Diamond (1974b, section 12) and Green (1976), this no longer holds when different agents do not incur the same costs for injury prevention. This is a well-known result. Regulation must be specific to the firm to induce the efficient level of injury prevention in each company, since their technologies differ, etc. Usually in cases where a rule involves negligence and/or contributory negligence, some companies and/or employees will be forced to take excessive precautions, while others (that have low prevention costs) will be able to avoid taking adequate precautions.

Now, as we shall see Swedish WE regulations are not uniform. On the other hand, they are not specific to the firm either. To the extent that they are specific to the firm these inefficiencies disappear. If they are applied uniformly, an inefficiency will arise in the sense that some companies will choose an "excessive" prevention level (we will return to the discussion of employee behaviour later). This is shown in Figure 2.2.⁴⁴ (Point C chosen instead of B.)

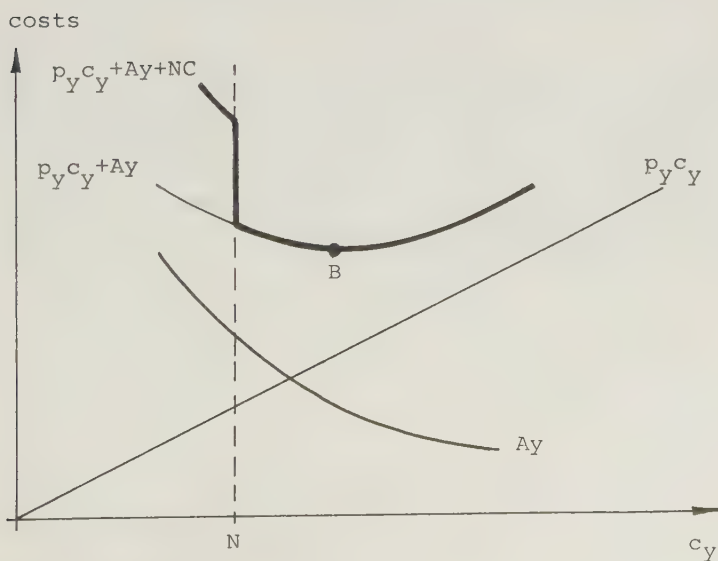
N is the prevention level required by the regulation. We disregard the Social Insurance system for the moment. Note that the regulation differs from a negligence rule in that the firm is not freed from injury costs just because it complies. There are only additional costs - NC - if it does not comply (costs for breaking the regulation). The thick line shows the total costs of the firm subject to the regulation. The firm chooses C instead of B (or D).

Figure 2.2: Inefficient choice of prevention level because of regulation



Note: NC = government imposed cost on negligent behaviour

Figure 2.3: Effect of regulation on a firm that would spontaneously have chosen $c_Y > N$



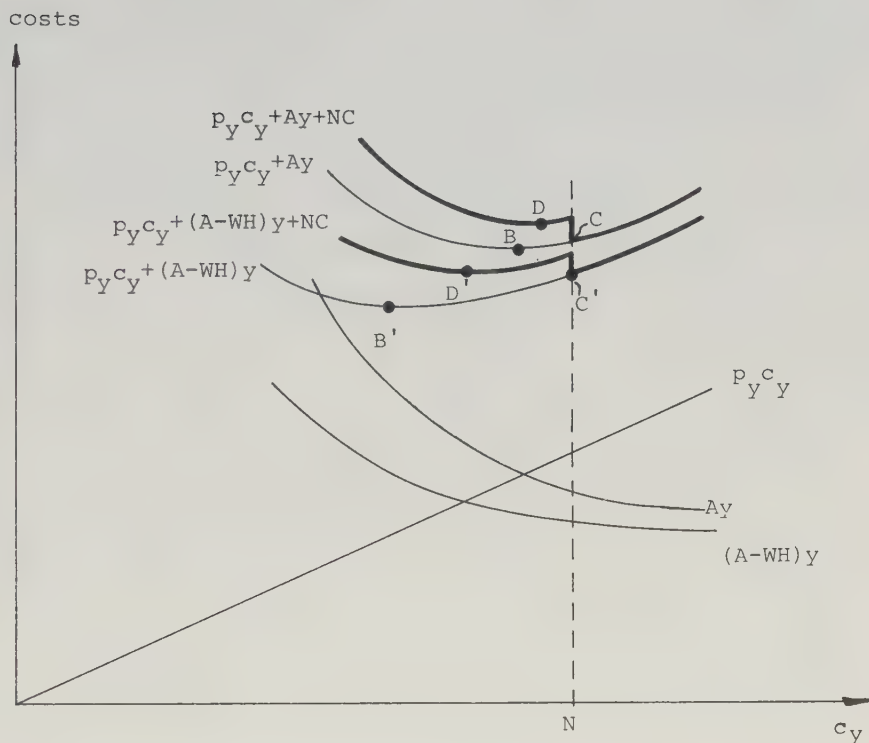
On the other hand, a WE regulation will not "induce" any company to choose a "too low" prevention level. This is shown in Figure 2.3. There we depict the situation of a firm that spontaneously would have chosen a prevention level in excess of the one required by regulation. The regulation does not alter this choice (point B).

As noted above, firms typically do not bear all injury costs up to the point where they are found negligent. The two Social Insurances will also bear part of these costs. This is true even when we take the law on torts into consideration, since social insurance benefits are deducted from the liability claims. The income loss restituted by the WII and the HI will constitute varying proportions of the total injury costs depending on the type of injury. Under a negligence rule, the lower level of cost borne by the negligent will influence the choice of prevention activity provided that it is large enough. In general, it makes it less likely that firms comply with the regulation. Companies that do comply will tend to decrease their prevention activity towards the regulated amount. Thus, the Social Insurance system also tends to decrease prevention in a situation where WE regulations are present.

This is shown in Figures 2.4, 2.5 and 2.6. In Figures 2.4 and 2.5 we retain the assumption that regulations are not specific to the firm. We begin in Figure 2.4 with a firm that is in the same situation as in Figure 2.2 - induced by regulation to choose point C instead of B.

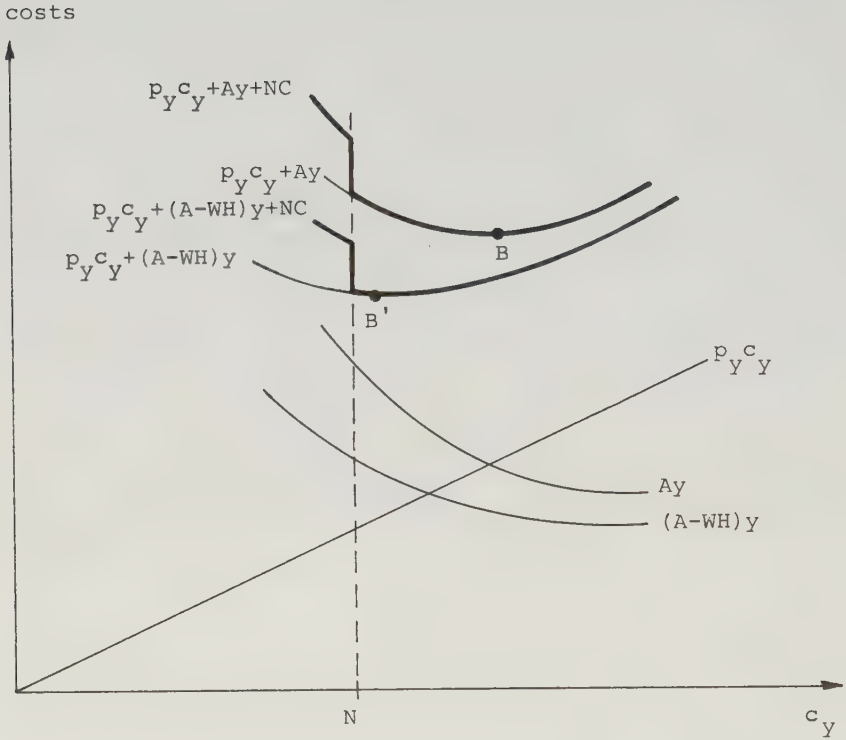
The WII and the HI are now introduced. The reduction WH in injury costs shifts the cost curves downwards; B' falls below and to the left of B; D' falls below and to the left of D. The difference between a pair of cost curves will be greater further to the left in the figure. (This difference is given by the difference between A_y and $(A-WH)_y$.) Thus it is more likely that D' falls below C', than that D falls below

Figure 2.4: Effect of the Social Insurance system on a firm that complies with regulation because of the costs of non-compliance



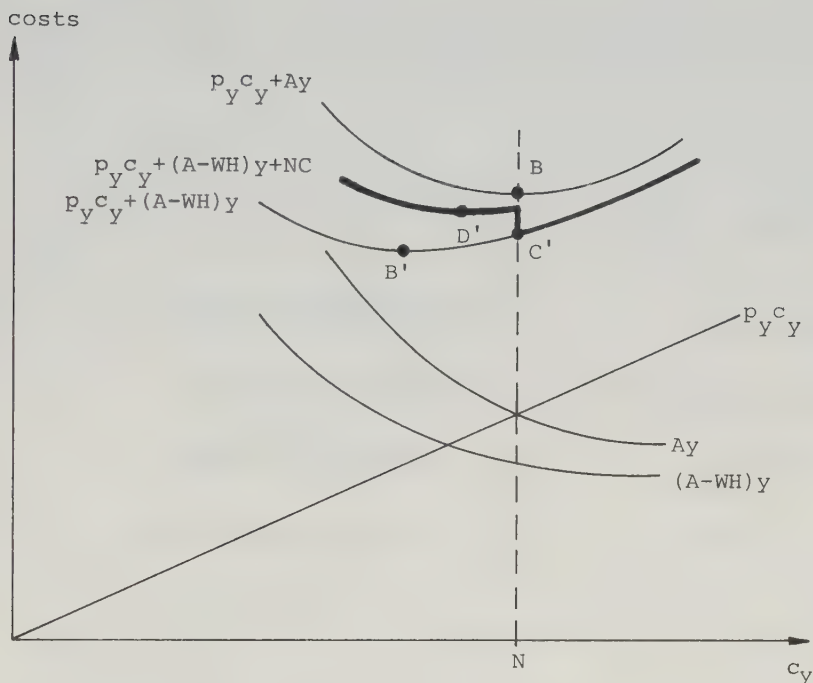
C. Non-compliance has become more probable. We see that D' may fall either to the left or to the right of B . In other words, regulation coupled with these Social Insurances may lead to more or to less prevention than no intervention at all. (The outcome depends inter alia on whether non-compliance costs varies with the prevention level.)

Figure 2.5: Effect of the Social Insurance system on a firm that would spontaneously have chosen $c_y > N$



In Figure 2.5 we show a firm in the same situation as in Figure 2.3 - a prevention level above the required one is chosen. Here the social insurance reduction in costs leads to less prevention. Point B' is chosen instead of B .

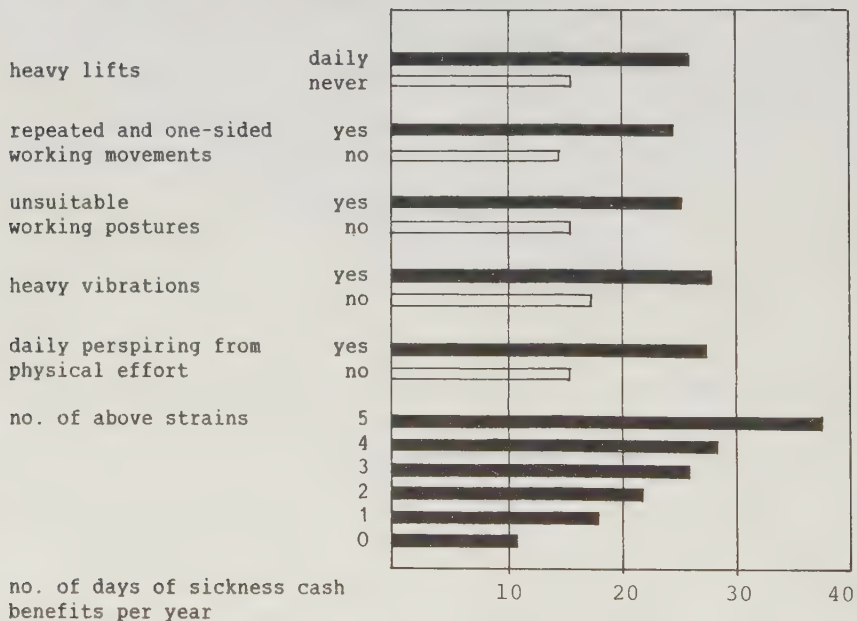
Figure 2.6: Regulation that is specific to the firm



In Figure 2.6 it is assumed that the regulation is entirely specific to the firm. In the absence of regulations, the firm would lower its prevention activity, as in Figure 2.1, to point B' because of the existence of the Social Insurance system. The prevention requirement would be put at N when the regulation was specific to the firm. If the non-compliance costs are large enough, this level will be chosen. As long as the non-compliance costs do not decrease when c_y decreases, the level of prevention chosen by the firm will not be lower with the regulation than without it.

So far we have only discussed occupational injuries. However, it is assumed in this study that part of the sickness absenteeism that is not classified as being due to work injuries is in fact WE dependent. In other words, persons with a worse WE will, *ceteris paribus*, be absent from work more often. This is supported by informal information of the type presented in Figure 2.7.

Figure 2.7: Absence from work and different measures of physical loading at work



Source: Living Conditions Report no. 15. Working Condition and Sickness Absenteeism.

In addition, it has been reasonably well established by statistical analyses (Living Conditions. Report no. 15. Working Condition and Sickness Absenteeism; Ohälsa och vårdutnyttjande, pp. 54-57). It is also intuitively very plausible. A bad WE will make people more prone to stay at home when healthy, and more reluctant to go to work when on the verge of being ill. In addition, a person who has a physically demanding job will be forced to stay at home in cases where other persons can go to work. A strained back or a sprained ankle would make

many physically demanding tasks impossible to perform. The same injury could be only a minor inconvenience for a white collar worker.⁴⁵ The same applies, mutatis mutandis, for mentally demanding work.

The HI also reduces company costs for sickness absenteeism (excluding occupational injuries) induced by the WE. Companies will therefore reduce their expenditures on WE items related to reductions in sickness absenteeism. Such an effect is suggested by Skogh (1977a). For this category, the HI part of the costs probably constitutes a greater share than for occupational injuries. For the individual, the burden in excess of income loss is relatively small. (It will vary with the kind of sickness.) Furthermore, the cost in terms of production losses, etc. (see above), is also lower. The resultant reduction in the portion of the cost borne by the company for the relevant WE conditions would increase the likelihood that any regulations would be ignored.

It should be noted that mandatory workers' compensation schemes may induce higher prevention levels. However, this requires that the costs for the ex post compensation rests with the individual company. Diamond (1977) has argued that an increase in the benefits to injured workers will decrease the difference between social and private costs (created by workers' under-estimation of risks). This is explained by the fact that these benefits "... are evaluated [by the firm] using correct probabilities while accident costs falling on workers and wage response to benefits are evaluated with incorrect probabilities. An increase in benefits increases the correctly measured accident costs and decreases the incorrectly measured ones." (Diamond, 1977, p. 79)⁴⁶

This conclusion has been contested by Rea (1981). He points to three reasons why the opposite may occur. First, workers may lower their precautions because of the increased coverage. Secondly, firms may lower their precautions because an increase in benefits will increase the worker's desire to substitute wages for safety. Thirdly, if firms increase their precautions this may lead to a corresponding reduction in precautions taken by workers (since the reward to preventive activity is decreased). The last result is also derived by Viscusi (1979b), and discussed in Viscusi (1983b, pp. 25-26) and Mendeloff (1979, p. 92).⁴⁷

These influences have been investigated by Chelius (1974; 1977, pp. 45-46, app. C; 1982). His empirical results suggest that higher compensation benefits induce employers to spend more on injury prevention, and that they induce employees to take less care. These results must however be treated with caution. Chelius acknowledges that incentives on reporting accidents and controlling the behaviour of injured workers may have contributed to his results. Butler and Worrall (1983) found a significant positive relationship between benefit levels in Workers' Compensation and injury claim rates; the latter might be interpreted as injury rates.

However as noted above, all of this discussion relates to the case where benefits paid to workers represent costs that are specific to a firm. There is no reason to doubt that the present Swedish system decreases the safety incentives of firms compared to the non-intervention case.

We conclude that the WII and the HI tend to decrease the amount spent by companies on the reduction of occupational injuries and sickness absenteeism. This is also the case given the WE regulations. The Social Insurance system also makes it less likely that compliance with the regulations will ensue. If employees underestimate the risks they face, this will tend to decrease prevention activities further. However, to the extent that regulations are specific to the firm they may fully counteract the tendency to decrease prevention (and may induce efficient prevention levels).

It is very important to note that the reduction in costs attributable to the Social Insurance system will have a similar effect on technical development. This will be biased towards technologies that possess greater inherent occupational hazards. (See further Chapter 4.)

As exemplified by the arguments of Rea above the actual effect on the number of occupational injuries will also depend on the reaction of employees to these factors. This depends on how the marginal benefit from individual injury prevention is affected when the company reduces its preventive activity.

Implications for the Incentives and Welfare of Employees

Up to this point, we have concentrated on decisions taken by the employer. It is now time to turn our attention to the situation confronting the employee. This introduces a new policy goal. Namely, that the risk-averse individual should be fully insured.

We will discuss the effects of public policy. However this will not give a complete view of the actual situation facing the employee. The employers' associations and the trade unions have agreed upon collective insurances for certain aspects of occupational injuries and sickness absenteeism. Following our analysis of public policy we will examine these insurances and discuss the implications of their existence and the form that they have been given (section 2.4).

The Social Insurance system provides the compensation to those injured and/or absent due to sickness. We will consider the amount of coverage and the behavioural incentives in the compensation system.

It is an indirect consequence of our earlier discussion that complete insurance will not be available. Nevertheless, insurance cover ought to be sought after. Increasing the insurance of the risk-averse individual will, ceteris paribus, increase welfare. As noted before, the rationale for ex post compensation is precisely that it eliminates uncertainty. In fact, in a world with only ex ante compensation (ignoring the insurance market, see below), the individual would bear all of the risks involved in uncertainty about the future.

We realize that there are two reasons why the employer cannot fully insure employees by means of ex post compensation. One is the transaction cost of such contracts. The other is the conceptual impossibility of compensating the dead. Unfortunately, the insurance market will not be able to overcome these problems either.

It is a well-known result from both workers' compensation and liability for accidents literature that employees are able to influence the probability of injuries and must be provided with incentives for efficient prevention activity.⁴⁸ Their position is in this respect parallel to that of the company. Obviously, the same argument applies to all aspects of the state of the world that are influenced by employee behaviour.

This is of course just another variant of the well-known moral hazard problem. The two standard solutions in economic analysis are less than complete coverage and/or observation of the behaviour of the insured. Thus, to fully insure individuals and to avoid moral hazard effects are two conflicting goals in the construction of this system.

It is convenient to begin by discussing the amount of coverage provided. We remind the reader that what is not compensated ex post (that is, is insured), will by assumption command ex ante compensation instead. In Table 2.1 we have summarized the distribution between ex ante and ex post compensation for different kinds of loss due to occupational injury. In practice, the behaviour of the individual

employee does not influence the size of the compensation (see p. 51).

Table 2.1: Compensation to victims of occupational injuries

<u>type of loss</u>	<u>provider of compensation</u>	
	<u>ex ante</u> compensation	<u>ex post</u> compensation
pecuniary loss: temporary condition	employer compensates for less than complete coverage in the Social Insurance system for cases of non-negligence	WII and HI, almost complete coverage in case of negligence the employer pays the difference up to complete coverage
pecuniary loss: permanent condition	- " -	WII and HI, highly variable amount of coverage in case of negligence the employer pays the difference up to complete coverage
non-pecuniary loss, except death and comatose condition	employer for cases of non-negligence	employer when negligent
death and comatose condition	employer	

Note: Non-market time is assumed to have no value in this table.

Before we proceed to analyze this system two things must be noted. One is that we are only dealing with WE effects that depend on the state of the world. This means that, for example, the disutility of working in a dangerous WE is not considered here (it will be ex ante compensated). The other fact concerns the value of non-market time. As stated in the note to the table it is given no value there. This has two implications. First, non-market time may have less value for the victim of an injury. The difference will be compensated ex ante by the

company. Secondly, an injury means that market-time is transferred to non-market time. From the point of view of the individual, it is the resulting difference in utility between these time-uses that should be compensated (Komesar, 1974). The amount of coverage in the insurance must therefore be evaluated against this net loss to the individual.

We begin with those occupational injuries that are so slight that the victim does not lose any market time. Then there is only non-pecuniary loss. This is compensated ex post if the company has been negligent; however, as mentioned above not all non-pecuniary losses are recognized by the law on torts. Hence for this type of injury, ex post compensation varies from full to zero. (Full ex post compensation: company negligent, all loss recognized by the law on torts); zero ex post compensation: company not negligent and/or no part of the loss recognized by the law).

In practice, two things influence this situation. Firstly, there are non-negligible costs associated with bringing a tort suit. At the very least, the individual has to offer some of his/her non-market time. As noted by Komesar (1974), the most natural assumption is that the individual values this at least as high as market time. For minor injuries, it is unlikely that the potential compensation for pain and suffering, etc., is large enough to make it worthwhile. (It is not likely that the individual will be remunerated for his input of non-market time, even if his suit is successful.)

Secondly, the individual can always choose to stay at home for a few days (cf. p. 50). As argued below, the income loss is often overcompensated for short periods. Whether this is a preferable option therefore depends on the psychic costs involved. Namely, there can be certain costs in terms of the displeasure of other employees as well as a longing for social contacts, etc. Moreover, it goes against the ethical rules in society to fraudulently stay at home from work.

All in all, ex post compensation will sometimes be less than full compensation if the individual remains at work. If s/he reports sick, the situation is equivalent to the next case to be considered (ethics apart).

Many who have suffered an occupational injury recover fully from their injury, although they may need to stay at home for a while. For many minor injuries of this kind, there is over-compensation in the sense that the compensation for income loss exceeds the difference between the value of market and non-market time. However, there is still the non-income loss to be considered. There is pain and suffering and, possibly, the psychic costs mentioned above. It is natural to suggest that the individual is left with less than full ex post coverage, for the simple reason that people normally prefer not to be injured.⁴⁹

As far as marginal utilities are concerned, this system seems close to the solution of "ideal insurance" (cf. p. 46). I have argued that for such minor injuries the marginal utility of money will not change materially. Because of the nearly total ex post compensation we thus almost achieve the equality of marginal utility of money between the different states of the world. (The voluntary insurances push us even closer to that solution, see section 2.4.) In the previous paragraph, it was argued that the utility level in the injured state is lower than in the non-injured state. Therefore, the moral hazard effect of this high coverage is not necessarily serious.

When we go on to consider other kinds of occupational injuries, we will abstain from discussing this aspect of the insurance. In the absence of more information regarding the marginal utility of money in different injury states, there is little point in pursuing these issues.

For more serious injuries, the amount of ex post coverage is probably lower. It is true that the average coverage for income loss increases with time. However, this is also true of the psychic cost of being away from work. Furthermore, the marginal value of additional non-market time decreases; and non-pecuniary losses such as pain and suffering is higher for more severe injuries. The only exception could be the case of a negligent firm. For these injuries it might be worthwhile to sue the company. However, the uncertainty involved in this option implies that the individual values liability claims at less than their mathematical expectation. It seems unlikely that this will be taken into consideration by courts.

As a rule, then, ex post coverage is highest for minor injuries. For more severe ones, the non-pecuniary loss is substantial, and the prospect of ex post compensation uncertain even in favourable cases. For fatal cases there is of course no ex post coverage.

We now turn to the moral hazard issue. Firstly is it meaningful to distinguish between risks for different injuries? The question is whether the individual can identify separate elements of hazard at the workplace. Corresponding to this identification there would be more than one preventive activity for the individual. My view is that such a separation is to a certain extent possible. Obviously, there are risky situations that could lead to almost any kind of injury. However there are also risks that it is reasonable to treat as only relevant for a sub-class of injuries. In particular, there are risks for minor injuries alone. The experiences of the slaughtering industry provides some illustrative evidence. It is the branch with the highest accident frequency rate in the whole economy. In 1975⁵⁰ it was more than twice as high as the average rate for the manufacturing industry (82.4 vs. 34.3). At the same time, the frequency of disabling injuries was close to the average (0.50 vs. 0.47), and the average injury was less disabling (12.8% disablement vs. 15.9%). No fatal accidents occurred in the branch. The number of sick-days per accident was among the lowest in the whole economy in 1979.

The Social Insurances under investigation deal only with pecuniary loss. There are two conditions that would lessen the usefulness of less than full coverage for financial loss as incentives for prevention. One is the degree to which individuals are not aware of or underestimate the risks. The other is if the coverage for non-pecuniary loss is so low that a less than full coverage for pecuniary loss is of negligible importance in comparison.

I would certainly argue that occupational injuries are frequent enough for individuals to be aware of their existence (see Chapter 1, n. 53). With respect to under-estimation of risks, I would suggest that this is most likely to occur with respect to serious injuries. They are a) less frequent, and b) more discomfoting to think about. For occupational diseases, an additional complication is that they are developed gradually. As argued above, the coverage for pecuniary loss will also be lower for such permanent injuries.

It is sometimes asserted that the non-pecuniary loss is sufficiently large for all occupational injuries to make the impact of a lowered financial coverage negligible. In agreement with Chelius (1977, pp. 11, 46) and Oi (1973) I consider that it is a priori likely that

financial incentives will affect behaviour with regard to risks for minor injuries. The results of Butler and Worrall (1983) and Chelius (1982) cited above (p. 65), also suggests that workers might respond to financial incentives in some risky situations.

To conclude, I contend that in principle it might be desirable to provide safety incentives by less than complete coverage for financial loss in the case of minor injuries. For more severe injuries it is unlikely that it would have a noticeable impact on the behaviour of employees. Therefore, there is no efficiency gain from less than full coverage in those cases. There is only a welfare loss.⁵¹ For these injuries it is arguable that the non-pecuniary loss already provides sufficient incentives.

It is not easy to say how the above compares to a hypothetical market outcome. I would suggest that the relation between compensation for minor and severe injuries respectively would be changed in favour of the latter. In terms of absolute levels, I venture the hypothesis that compensation for severe injuries would increase. For minor injuries, it is a question of weighing incentives against security. As noted by Diamond: "The tradeoff of getting more care from workers at the cost of having them bear accident costs without insurance may be a poor one." (Diamond, 1977, p. 85.) However, the compulsory nature of the insurance probably implies that at least some are overinsured (cf. the discussion below). It is noteworthy that 67% of all self-employed persons have chosen three waiting days in their WII.⁵² One should also consider the incentive to return to work, especially for minor injuries.

It should be noted that we assume that doctors are able to monitor the behaviour of individuals as regards return to work after a (longer) period of sickness. To the extent that this is not the case the above conclusion need to be modified. (Cf. also the the discussion below on sickness absenteeism.)

We now return to the case of sickness absenteeism related to work injuries. Table 2.2 shows the compensation scheme in the same manner as Table 2.1 did for injuries. A "bad" WE can both cause sickness and make a "slightly sick" person unable to work. In either case, one is

given ex post compensation for pecuniary loss from the HI. All discomfort, etc., is compensated ex ante by the firm.

Table 2.2: Compensation for work environment induced sickness absenteeism, other than related to occupational injuries (temporary condition only)

type of loss	<u>provider of compensation</u>	
	<u>ex ante</u> compensation	<u>ex post</u> compensation
pecuniary loss: temporary condition	employer compensates for less than complete coverage in the Social Insurance system	HI, almost complete coverage
non-pecuniary loss: temporary condition	employer	

Note: See Table 2.1, p. 68.

However, the risk of falling ill can only to a negligible extent be influenced by the individual. (At least, this seems a reasonable assumption.) Instead there is another kind of moral hazard here. The event which concerns us now is not "falling ill", but instead "staying at home due to illness." The decision to stay at home is taken entirely by the individual. No medical examination is needed until the sickness period has lasted more than five days. A doctor's certificate is then required. Obviously, the responsibility thus placed on the individual increases the potential for moral hazard effects.

The moral hazard refers to the possibility of staying at home for one or more days when one is not sick, or prolonging a period at home after recovery. It seems fairly certain that the sum of compensation for pecuniary loss and the value of non-market time exceeds the pecuniary loss for an individual who is not sick (or only so slightly that s/he could still work). The only negative effect in this case comes in the form of psychic costs, e.g. ethical disutility,

disutility of not seeing other people, displeasure of fellow employees, etc.

It is my contention that the efficiency gains from a lower amount of coverage would outweigh the welfare loss due to people being less fully insured.⁵³ In this case "ideal insurance" (equalizing marginal utilities) is not possible, because of the moral hazard. In other words, the present level of ex post coverage represents an over-insurance, in the sense that people would not voluntarily and individually have paid for it.

As noted above, it is assumed both in relation to the WII and to the HI that doctors are completely able to monitor individual behaviour once they are involved in the case. In particular, once a sick period exceeds five days they can determine when the individual should return to work. To the extent that this (obviously idealistic) condition is not fulfilled there is still a degree of latitude for the individual to influence his/her stay at home. This strengthens the moral hazard effect.⁵⁴

It should also be noted that the employer has no direct means of reducing this moral hazard effect. In contrast, the influence of employees on the risk of occupational injuries can be extensively monitored by the employer.

Another aspect of the WII and the HI will now be discussed. Namely, the fact that they are compulsory for all employees. As shown by Söderström (1983), the more compulsory coverage is raised above a guaranteed minimum standard of living,⁵⁵ the more people will be overinsured. In view of this, the present level of compulsory coverage would appear to imply that large groups are overinsured.

It is frequently assumed that it is the marginal worker who determines the level of compensation. On the other hand, the wage level and job characteristics will be equalized among a group of workers. This may create a tendency for all intra-marginal workers to receive a compensational surplus (Veljanovski, 1982a). In other words, they will receive more compensation for negatively valued WE characteristics than is warranted by the decrease in utility they entail.

Veljanovski noted that the surplus to intra-marginal workers will lead to an increase in the supply of WE improvements available to them. WE improvements in the nature of public goods would then be overprovided. (With the marginal worker determining the wage level and WE compensations, the cost of the public goods would exceed the sum of the individuals' willingness-to-pay in equilibrium.) For this to hold in our context, certain conditions must be fulfilled as regards the distribution of compensation payments. It must be the case that the marginal worker demands more compensation for occupational hazards (or other negatively valued WE characteristics) than the previous workers. This could follow from higher aversion to risk, more accurate perception of risk, etc. However it is not in fact certain, and the opposite may occur (cf. below).

It may be thought that over-compensation would lead to higher coverage in the ex post compensation offered by companies to intra-marginal workers. However this would be too rash a conclusion. True, the wage cum compensation bundle would then provides these workers with a compensational surplus. But this tells us nothing about the distribution of benefits between w , c , and X , nor of the construction of the ex post compensation system y that would be chosen.

We may note that the marginal worker may only have this position as potential employee, if the cost of changing job is high. At the same time such transaction costs create an opposing tendency to the one mentioned above. Viscusi (1980b) argues on theoretical and empirical grounds that marginal workers are new entrants, and that intra-marginal workers are usually older and wealthier. The latter consequently would tend to place a greater value on WE quality than the marginal worker (a result directly opposed to Veljanovski's), and tend to be undercompensated.

In fact, these matters will be handled by the trade union. The effects of the institutional framework in Sweden in this respect will be dealt with in Chapter 5. We just note that this means that the public goods aspects of the WE characteristics can be adequately dealt with by the union.

Finally, one might ask to what extent high compulsory benefits alters the allocation of workers to jobs. For example, would more risk-averse workers make greater efforts to find safe jobs if one lowered the amount of coverage? In principle, this should be the case, but personally I doubt that the WII and the HI have any significant impact on workers' behaviour in this respect. This is also roughly the position of Diamond (1977, section 9), but contrary to Viscusi (1983b p. 90).⁵⁶

Another question that arises is whether the effort of companies to match workers with jobs has been affected.⁵⁷ In general, the Social Insurance system decreases the profitability of allocating employees correctly with respect to occupational hazards and sickness absenteeism. Accident prevention can be accomplished by a company in a

number of ways. Making investments in increased safety and monitoring the behaviour of employees are two methods that are probably relatively uncontroversial. However, firms will also engage in screening of employees for different jobs.⁵⁸ Different opinions are more likely to arise with respect to these procedures. The more costly an accident is to a firm, the more effort would be put in to selecting workers. Thus, the existence of the Social Insurance system will decrease their incentive to try to hire employees who are assumed to be less prone to be involved in accidents. This effect is noted by Skogh (1977a,b).

From an efficiency point of view, screening is in principle desirable. (Assuming that the transaction costs involved are not excessive. These costs are borne by the company and the benefit of the screening will be weighed against costs.) There are two sides to this problem. Certain persons may be more prone to be involved in accidents, and/or likely to have a more costly accident. In both cases, it is more efficient that such persons work in low-risk industries. This would probably ensue, since it would be more remunerative for high-risk companies to select other kinds of employees.

There are of course other aspects that one might want to consider. For example, in the absence of the Social Insurance system, persons who have "high expected accident costs" would generally command lower wages in the labour market (Viscusi, 1983b, p. 133). If wage differentials on these grounds are not allowed to exist, these employees would now have less difficulty in finding employment than would otherwise have been the case. Any existing prejudices concerning "accident proneness" will also become less important. It may also be noted that there will be less pressure on employees to quickly return to work after an injury.

Similarly in the case of sickness absenteeism, the HI makes screening of "sickly" persons less profitable for companies. Hence, it is easier for these persons to find employment, and their wages may be correspondingly higher. It should be noted that screening of sickly persons would otherwise have existed throughout the economy. This is in contrast to accident-proneness, the screening of which may never be profitable in more than a limited number of activities.

In summary, it is our contention that the Social Insurance system overinsures large groups of people with respect to certain events. This means that the level of ex post compensation is higher than the amount that they would individually have been willing to pay for. Over-insurance is most obvious for sickness absenteeism. Moreover, it may well exist with respect to minor injuries. To what extent this over-insurance implies welfare losses for those concerned is another matter. It depends critically on whether the payroll tax that finances the system is shifted to workers. If a total shift occurs, this would imply that the overinsured would suffer a loss of welfare.

If employees underestimate their occupational risks, they will in all probability tend to underinsure for these risks (Diamond, 1977).⁵⁹ In other words, they would buy additional coverage if they were correctly informed. If this is the case, the two Social Insurances represent an even greater increase in coverage compared to non-intervention. The welfare effects of the total system become less clear in this case. However, marginal decreases in coverage would still be preferable for large groups if they pay for the insurances.

2.4 The Labour Market Insurances

The analysis of the compensation issue would not be complete if we did not include those private insurance arrangements that actually exist in this area. Although it is not possible to include individual insurance arrangements, there are two collective insurances to be considered.

These are private insurance schemes, provided by the employers. One is a labour market no-fault liability insurance (trygghetsförsäkring vid arbetsskada, TFA), the other is a sick pay and disability pension insurance (avtalsgruppsjukförsäkring, AGS).

In cases of occupational injury, the TFA pays benefits in accordance with tort liability rules, regardless of whether somebody has been negligent. This means that all pecuniary loss (including incomes in excess of 7.5 times the basic amount) is compensated. In addition, non-pecuniary loss, such as pain and suffering, is compensated. All

social insurance benefits are deducted. Employees covered by the insurance thereby renounce the right to appeal to the law on torts. The insurance is financed by payroll "taxes". These are largely uniform - the only differentiation of importance being between blue collar and white collar workers (one also differentiates between private, cooperative and municipal employers).

The AGS pays benefits (sickness cash benefits and disability pensions) that complement the HI, thereby increasing the coverage. It is financed by a payroll "tax" which is only differentiated with respect to private and municipal employers.

The first thing to be noted about these insurances is that they are not included in the tax base for the ordinary payroll tax. This means that they constitute a cheap way of providing employees with pecuniary benefits.

The payroll tax has a uniform rate of 33%. Obviously, this makes it relatively advantageous to transfer taxed wage differentials (ex ante compensation) to untaxed insurance benefits (ex post compensation). One unit of ex ante pecuniary benefits, net of payroll tax, yields 1.33 units of (expected) ex post benefits. We observed in section 2.2 that damages paid to employees are tax deductible for the company. This implicit subsidy is lost with the TFA. However, it is most probably only in a small minority of occupational injuries that negligence can be shown, and where the subsidy would have existed. Therefore, the TFA still represents a clear saving for the parties to the labour market contract.

As mentioned above, the TFA replaces the law on torts, and extends the ex post benefits for pain and suffering, etc., to cases where the company has not been negligent. Note that by assumption this does not affect the total costs of the company (cf. Table 2.1). It is just a question of adjusting the distribution between ex ante and ex post compensation. (The financing of the TFA of course changes the costs of the company.⁶⁰)

With respect to pecuniary benefits, the construction of the insurance is what might be expected from our discussion in section 2.1. We did argue, however, that it is difficult to provide ex post benefits for the type of non-pecuniary disutility considered by the TFA. However we should not be surprised given the implicit subsidy to this kind of pecuniary ex post benefits. As might be expected, the TFA compensations are standardized. The remainder of the non-pecuniary disutility will, as before, command compensating wage differentials or other ex ante compensation. The individual is able to purchase additional insurance privately.

Through the TFA, part of the previously firm-specific costs are transferred to uniform "taxes". As argued in section 2.3, this kind of change will reduce prevention activity.

The real "losers" would seem to be low-risk industries and their employees. In terms of resource allocation, the effects of the TFA are roughly equivalent to the effects of the Social Insurance system. However, as noted above, there is, in contrast to the public insurances, some differentiation of the premiums. This eliminates the most conspicuous differences between branches. Once again, the implicit tax-subsidy should nevertheless make the system attractive to all companies and their employees.

This still does not explain why one has not chosen a system with perfectly differentiated premiums. Of course, this may be a result of the internal structure and/or ideology of the labour market organizations, or a matter of administrative costs, or it may be thought that differentiation would lead to the TFA being included in the tax base for the payroll tax. For the present, this question will have to remain unanswered.

Most of what has been said about the TFA is also relevant for the AGS, mutatis mutandis. One point merits some additional attention. The AGS (as the TFA) provides additional sickness cash benefits. It is also a voluntary insurance. However this cannot be used to justify the high level of compulsory coverage in the Social Insurance system. The subsidy entailed in this system has been discussed above. (The benefits from the AGS are not even included in the tax base for the personal income tax.) Furthermore, the effect on incentives of

increasing coverage which is already almost complete is arguably negligible. For the same reason, the costs of this insurance are relatively low.

Notes to Chapter 2

1. Though one can theoretically envisage a situation where uniform wages will be preferable for those concerned. Lundahl (1980) discusses the case where a trade union can choose between wage differentials, and uniform wages with the union doing the redistribution "afterwards." He shows in a 2-sector general equilibrium model that it might increase welfare for the union to opt for uniform wages. (The outcome depends on a complex interplay of many factors.)

2. If it is the marginal worker who determines the magnitude of company payments to employees, then it is enough that s/he is well-informed and mobile, and representative of employee preferences (Smith, 1976, p. 31; Chelius, 1977, p. 37).

3. Of course, the WE is a part of our total environment. What happens there will affect the natural environment, even if the workplace is indoors. For example emissions of chemicals in the WE will eventually end up in the natural environment. However we will not discuss this relationship in our study. Our attention will be confined to the workplace and the people working there.

4. Environmental externalities have long been the object of economic analysis. For some recent contributions, see for example Baumol (1972) and Brown and Holahan (1980).

5. Note also the convincing explanation for the genesis of workers' protection legislation offered by Ahonen (1983, pp. 52-54). The introduction of wage-labour created an "externality" hitherto unknown (on such a scale). Previously, individuals had been living in closely knit communities, where those engaged in a production unit also had to care for victims of injuries.

A similar view is found in Moberg et al. (1982, pp. 144-145).

6. N.b. a number of the studies are theoretically unsatisfactory. See Smith (1979a) for a critical discussion, and Pedersen (1982) for a recent elucidatory exposition. Duncan and Holmlund (1983) discuss the bias in different kinds of estimates. In addition, the empirical evidence is far from consistent (see Brown (1980), Dickens (1984) and Smith (1979a)).

7. In my opinion international comparisons in the field of occupational injuries and the WE generally are very difficult to carry out. (That it is not impossible is shown by Kelman (1981b).) Superficial comparisons have often a very limited value. The whole area is heavily influenced by social and cultural factors. In addition, the structure of the labour market will play a significant role for the outcome as regards the WE. For comparisons to be meaningful without a detailed investigation of the above mentioned aspects, it is therefore necessary to only use countries that are as "alike" as possible. For Sweden, the closest object of comparison are the other Nordic countries. Socially and culturally, the similarities

are greatest in these areas. Furthermore, the structure of the labour market are also quite similar. (A citizen of one Nordic country is free to seek employment in any of the other countries.)

8. See Chapter 6 for a further discussion of these results.

9. Note the difference with the wage structure issue. An efficient form of wage payment has ex post elements (cf. Chapter 1, n. 40). However from the point of view of the employee, those elements introduce an element of uncertainty. Holmström (1981, 1983) has shown that the employer may insure the employees against short run variations in the wage level.

10. The format of expected utility maximization should not be used indiscriminately in the case of occupational hazards. One aspect of the latter may be troublesome in relation to this framework, and that is the fear that arises from being in dangerous situations (Diamond, 1977, p. 68 n. 2). Viscusi (1979a, ch. 5, app. E) analyzes the effect of "anxiety" on workers' job choice.

In the present context, disutility from being in dangerous situations could perhaps be interpreted as a wish to equate the utility (not marginal utility) of different states of the world. Starting from ex ante compensation, an additional positive effect for the individual may arise from the transfer of some of it to ex post compensation. Normally, the two "goals" will come into conflict as the amount of insurance coverage (ex post compensation) is increased.

11. Although not all of this is WE related, I would contend that some of it is. See further the discussion on pp. 64-65.

12. This result is in line with the major findings in the empirical literature on compensating wage differentials. Risk of death is more often associated with wage differentials than other WE characteristics such as injury frequency rates (Smith, 1979a). An exception is Pedersen (1982). See also the discussion in Dickens (1984).

13. In the U.S.A., a variety of arrangements exist (Chelius, 1977, pp. 25-26). Some firms self-insure, some are insured with experience rated premiums, and some are insured without experience rating.

14. A similar division is found in Viscusi (1980a).

15. In 1979 payments from the WII to occupationally injured persons amounted to 928 million SEK, and the payments from the HI can be estimated at 594 million SEK. See Appendix 2.

16. For a more extensive presentation in English of these Social Insurances, see Edebalk and Elmér (1983). For a full presentation of the WII, see Grönwall and Hessmark (1981).

17. The basic amount is indexed to the cost of living. It is seen as some kind of minimum subsistence per annum (Edebalk and Elmér, 1983).

18. In addition, benefits are sometimes not paid for the first weekend. Thus, there can be a maximum of three days of totally uncompensated income losses.

19. Except in some special cases. Cf. the Work Injury Insurance Act (lagen om arbetsskadeförsäkring, LAF), 4th ch. 7th-10th sections.

20. Hellner (1976), p. 224. See this work for a full presentation of Swedish law on torts.

21. The restrictions in the scope of liability in Sweden are approximately those that Shavell (1980a) identifies as economically effective. See Hellner (1976), pp. 143, and 147-149.

22. The Act on Torts 6th ch. 1st section 1st par.

In fatal cases, the victim must have willfully contributed to the injury for a decrease in the claim to be possible. (Ibid.)

23. Cf. the Act on Torts 5th ch. 3rd section.

24. The Act on Torts 5th ch. 1st section 1st par., and Hellner (1976) pp. 271- 274.

25. Hellner (1976), p. 270.

26. According to the tax department at the County Administration (länsstyrelsen), this would probably include occupational accidents (conversation with the present author). (As will be explained in section 2.4, this is a hypothetical question.)

27. Possibly also to his/her friends. This is ignored, however, since it can be assumed to be of relatively minor importance.

28. At the same time, this becomes an implicit comparison with another kind of public policy. Namely, one where individual companies are given an increased responsibility for these costs.

29. As shown by Chelius (1976) the compensation demanded may be smaller than the payments from even a modest injury insurance. This implies that transaction costs might prevent the transfer of costs to the company from being complete.

Cf. also the analysis of different liability rules in Shavell (1980b).

30. We do not consider the possibility of price increases. This is more interesting as a response to regulations, and is briefly discussed in section 3.6.

31. The analysis of Diamond (1974b, section 11), though conducted within a model with restrictive assumptions, illustrates the difficulty of achieving efficiency in this type of case.

32. We assume that both the probability and possible magnitude of accidents are regulated at the same time. The problem discussed by Diamond (1974b, section 11) where the magnitude is an additional non-controlled variable is thereby avoided. Thus, what is regulated is in fact not only c , but also A where A is the cost of an accident. A_y is the expected y accident cost.

33. Polinsky (1980) uses a formal model. For references to informal discussions of this point, see Polinsky p. 363 and n. 2 *ibid*.

34. See also the analysis of employment effects under different liability rules in Veljanovski (1982a). He shows *inter alia* that in a competitive market with no employer liability, the employer may in fact turn out to bear more than the full accident costs.

35. As will be more extensively discussed in Chapter 5, the tax will also cause a shift away from pecuniary benefits towards non-pecuniary ones. This will favour activities where it is relatively easy to provide non-pecuniary benefits. I will not venture any hypothesis as to how this dimension correlates with the amount of negatively valued WE characteristics (in particular occupational injuries) present in different activities.

36. A similar observation for the U.S.A. is made by Viscusi (1983b, p. 159).

37. At the same time, the choice of a payroll tax to finance the WII and the HI tends to operate in the opposite direction. The payroll tax increases the marginal taxation of pecuniary benefits. This will cause the composition of the employment contract to change - pecuniary benefits will decrease and non-pecuniary increase (at the margin). Injury prevention belongs to the latter category. Thus, as suggested by Ståhl (1972) the tax-effect is to increase prevention. However, it is highly unlikely that this effect will be strong enough to fully counteract the decrease in prevention mentioned in the text. See further Appendix 1, and Chapter 5.

38. The same general point is made by Chelius (1977, p. 36). He notes that it is possible that some small firms would never face experience rating, because of the administrative costs (*ibid.*, p. 51).

The central role of the insurance system in the shaping of incentives is frequently commented upon in the literature. (Such as in Ahonen (1983, pp. 18, 43, 60), Diamond (1977), Nichols and Zeckhauser (1977), Russel (1974) and Viscusi (1983b, p. 90).)

39. This argument assumes that the Social Insurance system provides identically the same insurance coverage as would ensue without this intervention. It will be argued below that the Social Insurance system overinsures individuals at the margin. How does this over-insurance affect our argument?

Assume now that those overinsured represent the employees in negotiations on the employment contract. At the margin, the direct injury cost (A) does not change, but the payroll tax (T) increases. If this tax-increase is totally shifted to employees (P does not change) the forces governing prevention activity will tend to move in opposing directions. First, the utility of all employees will decrease, and this would tend to decrease prevention. Secondly, employees will tend to substitute wages for safety, their utility of a given c_y having decreased (Rea, 1981). Thirdly, there will be a shift^y towards pecuniary benefits, thus increasing prevention.

Assume now that the burden of the tax is shared, in such a way that employee utility is not changed. This implies that the tax is shifted to employees to the extent that they value the increase in insurance coverage. In this case, the first effect above disappears. This leaves us with two conflicting tendencies. (If an even smaller share of the tax falls on employees their utility will increase. This implies that the tendency for prevention to increase will be strengthened.)

The same may occur if employees tend to underinsure for occupational risks. Suppose that they do, because they underestimate these risks. Suppose further that the Social Insurance system is based on correct probabilities and provides employees with the benefits that they would have chosen if they had known these probabilities. Assume now that the subjective probabilities do not change because of the Social Insurance system. Employees will then judge themselves to be overinsured at the margin, and the arguments above are applicable.

40. In formal terms we have profit $P = F(L) - Lw - p_Y C_Y - A_Y$, with L and w fixed.

41. Such a view of WE regulations is suggested also in Nichols and Zeckhauser (1977, p. 45), and Viscusi (1983b, p. 79).

Incidentally, it may also be seen the other way around. If one assumes that WE regulations provide sufficient incentives for prevention, then one is free to construct the WII without considering the effects on prevention activity.

42. In the case of the AML these costs take the form of fines. With an "ordinary" negligence rule, it would be the injury costs instead. However this is of no consequence for the argument here. See further the discussion below in the text.

43. In principle, we can also include the statutes of the penal code concerning the causing of another person's death, injury, etc. These also entail convicting the negligent. In this sense the analysis would parallel that of the law on torts. Historically the penal code has seldom been evoked in connection with occupational injuries, however (Flodgren, Hydén and Sandström, 1981). Despite an increase in later years, it is still far from common, cf. Chapter 3, n. 17.

44. The figure is drawn so that the company in question chooses to comply. Of course, it is quite possible that this will not be the case, for example if the cost of non-compliance is low. (Point D chosen.) In such a case, the regulation only brings enforcement costs.

45. This is not a negligible factor. According to the Swedish survey of living conditions 66% of all economically active persons had a job that was physically demanding in at least one respect in 1979 (Living Conditions. Report no. 32. Working Environment 1979).

46. See also Viscusi (1980a), where a sufficiently merit-rated workers' compensation scheme is shown to increase safety, provided that workers have unbiased but imprecise information on risks.

47. Incidentally, it ought to work the other way too. If the Social Insurance system induces employees to lower their precautions, this will increase the return to preventive activities undertaken by the firm (as well as to the employer's efforts to monitor employee behaviour).

48. As shown by Ehrlich and Becker (1972), it is sometimes useful to distinguish between efforts to reduce the size of a loss ("self-insurance") and to reduce the probability of loss ("self-protection"). The individual employee can both self-insure and self-protect in the WE. In principle the Social Insurance system should reduce both activities. The same holds, mutatis mutandis, for companies.

Another form of individual self-insurance that will be affected is savings.

49. In addition, one does not hear of people voluntarily injuring themselves. However, this is not a decisive argument. The reason for this may be a combination of uncertainty about the outcome of self-inflicting injuries and risk aversion. (Thus, the mathematically expected compensation may still be more than full.)

50. We are forced to make use of rather old data, because the registration of disabling injuries cannot be used for later years.

51. This is the same kind of logic as that of Shavell (1980a) in his discussion of how to restrict the scope of liability.

52. Occupational Injuries 1979, Table III:10, p. 51.

53. It has been empirically verified that sickness absenteeism varies with the amount of coverage, see Bentzen, Christiansen and Pedersen (1984).

54. It is probably too optimistic to regard the monitoring carried out by doctors to be even approximately perfect. It might be desirable to try to improve it. Recently, one has tried to change the system to eliminate the possible use of several doctors without the latter being aware of it. Another variant would be to provide doctors with incentives to correctly assess the need for sickness absenteeism, in addition to those already in existence as a result of professional ethics. It would probably be preferable to make the award of excessive sick leaves punishable, rather than to reward restrictive practice with respect to sick leave. The latter would tend to conflict more with the doctor-patient relationship. Indeed, any proposal in this vein is likely to meet with resistance from doctors due to the negative effects on this relationship. (This happened to the reform proposal mentioned above.)

55. However, merit wants might provide a reason for slightly higher compulsory coverage. On the other hand, I do not agree with Diamond (1977), who seem to imply that this (his "self-paternalism") could be used to justify more extensive public intervention.

56. For an analysis of workers' self-selection, see Viscusi (1979a, chapters 6-8).

57. It may also affect employers' voluntary provision of information to employees. This influences workers' self-selection. For an analysis of employer behaviour with respect to such provision, see Viscusi (1979a, chapters 8-9).

58. The situation of the less than perfectly informed employer is analyzed in Veljanovski (1982a) and Viscusi (1979a, chapters 6-7).

59. But see also the ambiguous results in Rea (1981).

60. From the point of view of companies, this becomes an insurance against large liability claims. To the extent that the firms exhibit risk aversion towards large losses, they are now more likely to cause situations where many employees are injured (Ashford et al., 1980, pp. 91-92).

From the point of view of employees, the TFA is also a mutual liability insurance.

3 WORK ENVIRONMENT REGULATIONS AND ECONOMIC INCENTIVES

In this chapter we will deal with a number of policy measures whose goal is to directly change company decisions on the WE. These measures comprise on the one hand WE regulations, and on the other direct economic incentives i.e. taxes and subsidies. This distinction is of course more a conceptual than a real one, since in economic analysis regulations are typically viewed as changes in the cost structure facing the firm.

The following are the main conclusion from the analysis in this chapter:

It could be argued that the WE regulations have had no significant impact on the WE. However, a good case can be made in favour of their positive influence on the quality of the WE. In either case, costs of control would fall on public authorities instead of on the parties on the labour market.

Given full compliance with uniform regulations:

Basically, employees would gain at the employers expense. However, if the regulation corrected a "suboptimal" employment contract, both parties may stand to gain.

Regulations will affect competition among firms and industries. The interests of potential entrants are unlikely to be considered.

The advantage of high-risk firms and industries due to the Social Insurance system and to workers' under-estimation of risks would be mitigated. The tendency of these factors to bias technological development towards lower WE quality would be counteracted (as would to some extent the prevention decreasing effect).

Regulations could conceivably be used to increase WE quality against the wishes of both parties on the labour market.

Compliance will not be complete. Moreover, the enforcement usually takes the form of negotiated compliance (this often being a preferable strategy for the labour inspectorate), and some variations in WE quality are allowed. The above mentioned effects

would then be modified in so far as the increases in WE quality induced by regulations will be smaller (and unpredictable).

Finally, the WE subsidies used in Sweden are shown to have increased certain kinds of WE investments. However, the effect on total WE investments is uncertain.

The WE is directly affected by regulations in a number of areas.¹ However, by far the most important is the Work Environment Act (Arbetsmiljölagen, AML). In 1978 the AML replaced earlier legislation for workers' protection.² Our attention will be confined to this Act. However, we will be dealing with the general properties of these regulations in our analysis, and not discuss specific rules. Therefore, the effects of other regulations could often be relatively easily envisaged against this background.

In the AML one finds stipulations concerning many WE related areas, such as obligations to provide information, the organization of workers' safety representatives, etc. In this chapter, however, we are mainly concerned with those statutes that directly relate to the shaping and control of the WE.

The AML presents requirements and obligations in general and far-reaching terms. However, for our purposes it will be argued that this body of law can be analyzed in terms of regulations. It will be suggested that there will be a major effect on actual decisions only in so far as the requirements, etc., are specified - that is, become regulations.

It should also be emphasized that it will not be possible within the scope of this study to go into details regarding the Swedish regulatory effort. Instead, we will confine ourselves to the establishment of some major properties of the system. As argued in Chapter 1, there are good reasons for investigating the decision structure before turning, for example, to specific regulations.³ It is suggested that this represents an important contribution to our understanding of the effects of these regulations.

Throughout this chapter, we will assume that enacted WE regulations raise production costs in at least one firm.⁴ More specifically, we assume that P is lowered. This means that regulations that meet with no resistance from employers are left out of our presentation. This is done not because they would be non-existent, but because they are less interesting for our analysis. Moreover, some regulations might meet only a "token resistance". It is conceivable that such behaviour exists (for tactical or other reasons). However this is not something that we will deal with here.

In the previous chapter, we noted a number of properties of regulation policy. We argued there that the use of WE regulations can be seen as one possible way of attempting to cope with the problems created by the insurance system. Here we will take one step further and take account of the method used for implementing the regulations (typically negotiated compliance, cf. below), and of how the negotiations between employers and employees are affected.

The rest of this chapter is structured in the following way. In section 3.1 we present the way the WE is regulated in Sweden, and how these regulations are enforced. In section 3.2 we discuss the possibility that this public policy is a perfect substitute for labour market negotiations, and consequently has no direct impact on the WE. We then argue in section 3.3 that there are good reasons for assuming that the regulations entail an effort to increase WE quality. Given this assumption, we then analyze the effects of WE regulations for a simple case, in section 3.4. In that section we make two simplifying assumptions, namely that regulations are uniform and that all firms comply with them. In section 3.5 we introduce the actual enforcement system, and see how this affects the results derived in section 3.4. This means that we relax both the above mentioned simplifying assumptions. Not only may compliance be partial, but the demands on the WE may vary between firms. Many of the results from section 3.4 are affected by this, and typically become less clearcut. In section 3.6 we briefly discuss the case of variable product prices.

We then turn to the traditional economic incentives - taxes and subsidies - which represent an alternative to regulations. First we make some notes on their general applicability to the WE field in section 3.7. After that, in section 3.8, we review the limited Swedish experience of such measures; two forms of subsidies to WE investments.

3.1 Work Environment Regulations in Sweden

The AML⁵ stipulates that the WE shall be satisfactory, given the nature of the work and the social and technological development in society. Furthermore, it states that working conditions shall be adapted to human qualifications.⁶ The stipulations in the Act concerning the shaping of the WE are throughout phrased in such highly general terms.

One should not underestimate the effect of such policy oriented statements. They proclaim what should be the attitude to these questions in Swedish society. There are also statutes to the effect that employers and employees shall cooperate to achieve a good WE.⁷ Furthermore, the AML has increased the influence of employees on WE decisions in individual companies (Nordfors, 1985, p. 148). In all probability, this raises the quality of the WE. However, as stated before, we deal only with those questions where there is an economic conflict of interest concerning the shaping of the WE.⁸ Notwithstanding the (probable) existence of altruism, it is my contention that major changes of the kind in question will not be brought about by fine sounding declarations, even when they appear in the code of laws.

The National Board of Occupational Safety and Health (Arbeterskyddsstyrelsen, ASS) is the central authority in the field of workers' protection. It is responsible for the administration of the AML and of related legislation (such as the legislation on working hours).⁹ The ASS is authorized to issue rules that specify the demands on the WE. It also provides advice and information on these matters. The actual control of the observance of the AML is entrusted to the Labour Inspectorate (Yrkesinspektionen, YI) under the authority of the ASS. Sweden is divided into 19 Labour Inspectorate districts.

Employers' and employees' organizations play an important part in the regulatory process. They are repeatedly consulted during the process of preparation of the regulation (see, for example, Lundberg, 1982, p. 77). The final decision on WE regulations is taken by the board of the ASS. Two of the 11 members of this board are ASS officials, four represent the trade unions, three represent the employers' associations, and two are politicians.¹⁰ The activities of the YI in a district are directed by the district manager and by a Labour

Inspectorate committee. Among other things, the latter is responsible for orders and prohibitions (see below). The committee has nine members: the district manager, four trade union representatives, and four representatives for employers' associations.¹¹

The rules issued by the ASS can be of two kinds. For some regulations, non-compliance automatically leads to punishment (fine or imprisonment). However this is generally not the case. In the other instances, when the YI detects a non-compliance, an order or prohibition can be issued. These can be issued under the penalty of a fine, which is imposed by means of court proceedings, should non-compliance ensue.¹² In other words, non-compliance with these latter regulations only leads to punishment after detection and refusal to subsequently comply.

If a company has been made subject to an order or a prohibition, it can file a protest against this with the ASS. An appeal to the government can be made against the decision of the ASS.¹³ However, the YI can order that their decision shall be obeyed immediately, before it has acquired legal force.¹⁴

The control by the YI is carried out by a number of inspectors who visit various workplaces according to their own choice. The inspector and the YI generally have a considerable amount of discretion in dealings with unsatisfactory WE conditions. The regulations issued by the ASS are often not very specific, and the inspector is left to form a judgement on the appropriate level of WE improvements to be enforced. Furthermore, the inspector can choose between legal sanctions, and a "softer" approach based on briefings and advice. The instructions for the YI as a whole also stresses that inspectors have consultative and cooperative functions. As argued by Lundberg (1982), the YI (and the ASS) has consequently a double and somewhat ambiguous function - both policeman and adviser.¹⁵

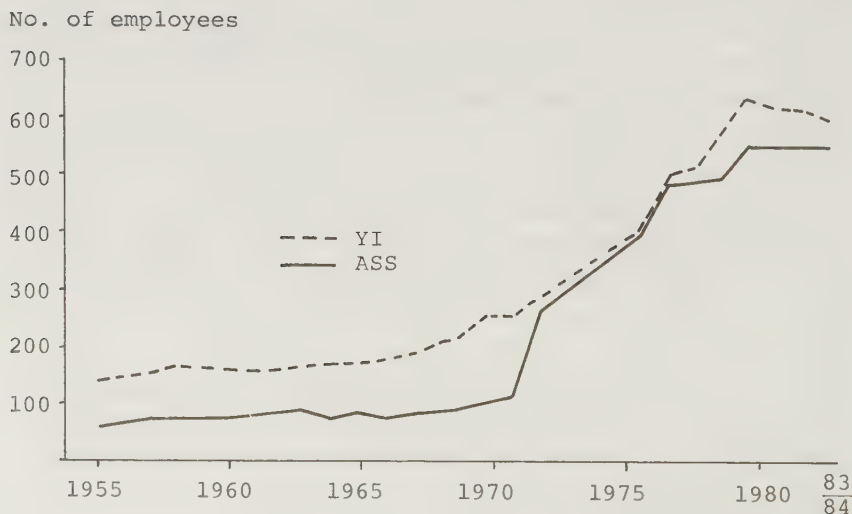
An important role in the control of the AML is played by the safety steward. The organization of safety stewards is highly developed in Sweden. Every workplace with at least five employees is required to have one. Among other things, the safety steward participates in planning of production, has a right to stop the production process if workers are in danger, and can demand visits from the YI. The expenditure for the work undertaken by stewards is borne by the

company in question.¹⁶

The WE regulations have also another legal aspect. The provision in the Penal Code (Brottsbalken, BrB) regarding causing the death of a person (e.g. manslaughter by negligence), causing injury, etc.,¹⁷ can be relevant in cases of occupational injuries. It is then of great importance whether the rules issued by the ASS have been adhered to or not.¹⁸ As noted in Chapter 2, similar considerations apply to tort liability.

The resources of the ASS and the YI expanded considerably during the 1970s. This is illustrated in Figure 3.1, which shows the number of employees at the ASS and the YI. The budget of the two agencies was approximately 275 million SEK in 1983/84. At least 175 million SEK of this budget can be attributed to regulation and control.¹⁹ The YI alone had a budget of 125 million SEK.²⁰

Figure 3.1: Number of employees at the National Board of Occupational Safety and Health (ASS) and the Labour Inspectorate (YI) in 1955-1983/84



In economic studies of regulation, it is usually assumed that rules are strictly enforced, so that non-compliance when detected leads to punishment. However, as Fenn and Veljanovski (1984) and Veljanovski (1983a,b) correctly assert, it is now well-known that the enforcement of regulations often takes the form of "negotiated compliance".²¹ That is, instead of using legal sanctions, the enforcement official engages in bargaining to persuade the violator to comply. As argued by these authors, any meaningful policy-oriented analysis must take this feature of the enforcement process into account.

Kelman (1981b), Lundberg (1982), and Stearns (1979) have shown that the above picture is relevant to Swedish WE regulations. Lundberg is especially interesting since his work relates to the period after the passing of the AML. This Act opened up greater possibilities for a legalistic approach, but no major change seems to have taken place. Lundberg (1982) noted that orders and prohibitions were seldom used. This tendency has continued during the years following his work. (Edlund (1984) follows this tendency up to 1982.) Table 3.1 shows the number of orders and prohibitions issued by the YI, as well as the number of offences notified to police or public prosecution authorities.

The table illustrates that consistently less than 1 percent of inspections at work sites lead to the use of legal sanctions. This can hardly be due to the high quality of the WE since as many as 12-16,000 written inspection notices are issued each year.²² Furthermore, Stearns (1979) reports that about 90% of inspections led to detection of an offence.

The interviews with inspectors carried out by Lundberg (1982) also indicate that negotiated compliance is a preferred strategy on their part. It is also advocated as a first resort by the legislators and the ASS.²³ There can be a number of reasons for this strategy. However we postpone our discussion of these reasons until section 3.5.

Table 3.1: Survey of legal sanctions used by the Labour Inspectorate (YI) 1978-1983.

	1978	1979	1980	1981	1982	1983
Number of orders issued by the YI	129	140	140	132	130	100
Number of prohibitions issued by the YI	230	291	245	206	200	232
Total number of orders and prohibitions	359	431	385	338	330	332
Number of offences notified to police or public prosecution authorities by the YI	25	32	43	39	..	74
Number of orders and prohibitions as percentage of written inspection notices*	2.5	3.2	3.2	2.6	2.4	2.1
Number of orders and prohibitions as percentage of inspections of work sites	0.7	0.8	0.7	0.6	0.5	0.6

.. Information not available.

* See n. 22 regarding the trend of these percentages.

Note: This table only includes offences, etc., against the AML or other legislation for workers' protection. Notably, cases related to the laws on working hours, which is also controlled by the YI, are not included.

Sources: Arbeterskyddsstyrelsen och yrkesinspektionen:
verksamhetsberättelse, various years.

3.2 Regulations as a Perfect Substitute for Negotiations

At one extreme, it is possible to argue that in principle the WE regulations have had no direct impact on the shaping of the WE. This follows since it is conceivable that labour market negotiations would have produced the same institutional set-up.

The AML can be seen as consisting of two sets of regulations: those directing the negotiations or contacts between employer and employees concerning the WE, and those aimed at the WE itself.

The collective agreements on the WE specify that employer and employee shall cooperate to create a "satisfactory" WE.²⁴ For cases of disagreement regarding the interpretation or application of the collective agreement, the issue is conferred to an arbitration board.²⁵ This board is composed of two representatives for each party plus an impartial chairman.²⁶

The AML also states that the WE should be satisfactory. It is implemented by the ASS and the YI. At the top of both these organizations there are bodies that closely resemble arbitration boards (equal or almost equal representation for the parties,²⁷ and one or more "impartial" members).²⁸

It is thus not inconceivable that in the absence of legislation, a similar organization would have been created by the labour market parties.²⁹ The objective would have been to "enforce" the general "satisfactory"-clause at the level of the workplace. If this is taken to be the non-intervention alternative, then this implies that the legislation has not had any direct impact on the WE.

Hence the one major effect would be the subsidy implied by the government financing of the ASS and the YI. This is mainly a subsidy to activities that are subject to numerous occupational hazards, since this is the main concern of the ASS and the YI. (In particular activities subject to health risks, where control is extra costly. See also the next section on gains of a more intangible nature.)

Today, the ASS and the YI are partly financed from unspecified public revenue, and partly financed through a uniform payroll tax. In 1983/84 their income from this tax amounted to approximately 83 million SEK.³⁰ The cost of regulation and control carried out by the ASS and the YI amounted to at least 175 million SEK (see p. 92), which left about 90 million SEK to be covered by other public expenditure. In fact the share of costs are not distributed according to the "need" for control. (Note that this is in the nature of a net of tax benefit.)

The inspectors could then be interpreted as a substitute for trade union officials who carry out checks to ensure that employers fulfil their part of the contract.³¹ Normally, the costs of this control would be largely transferred to employers, since the need for

extensive control would be a disadvantage of working in hazardous industries. Alternatively the inspectors are first resort arbitrators. Nordfors (1985, p. 70) notes that inspectors are called in as arbitrators when disagreements arise within a firm's safety committee.

However, it is my contention that a rather convincing case can be made for granting the AML an effect in accordance with its generally declared goal - to increase WE quality. We will now turn to that case.

3.3 Regulations as a Measure to Increase Work Environment Quality

We will argue that there are good reasons to view the AML (and the ASS and the YI) as a measure that increases WE quality.³² For this argument, it is sufficient that the following three conditions are fulfilled: 1) the "third party" on the boards seeks to raise the quality of the WE, 2) higher levels of WE quality are desired by one of the labour market parties,³³ and 3) the law and the administrative organization can in practice influence the WE.

In this section, we will discuss the first two conditions. It will be argued that it is reasonable to assume that they are fulfilled. This means that there will be an effort on the part of the ASS and the YI to raise WE quality above the level that would otherwise have obtained. To what extent this effort will be successful (condition 3) above) will be the subject of sections 3.4-3.5.

The officials and politicians who are the third party on the board of the ASS and in the labour inspectorate committee are not in fact impartial arbitrators appointed by the labour market parties. The officials are state employees. The politicians are members of parliament. Given that the generally declared goal of this policy is to increase WE quality, it is a reasonable assumption that these persons consider that their function is to increase WE quality beyond what would have resulted without government intervention. Kelman (1981b) argues forcefully that this is in fact the case for ASS and YI officials. He also found that these officials constitute the group that has the greatest impact on decisions actually taken in these organizations (op. cit., ch. 3).

Will there then be a disagreement between employers and employees on the level of WE quality? From our general framework - with employee utility given - it might appear that there would not. However, it was emphasized in section 1.3 that we were concerned with tendencies rather than a perfect market solution. Consequently there will be some scope for reducing or increasing profits. It will be argued that employees are likely to gain from increases in WE quality induced by regulation.

A casual observer would soon notice that trade unions are constantly pressing for regulations to increase WE quality.³⁴ Although such facts should never be taken at face value without an analysis of the underlying forces, it does seem nevertheless inadvisable to totally disregard such manifestations. At the very least, they may be taken as an indication that employees may well stand to gain from the regulations.³⁵

In terms of our framework, it may well be envisaged that regulation-induced increases in WE quality would provide advantages for employees. In practice, compensation for negatively valued WE characteristics - such as occupational hazards - may well fail to equate the utility of different employments.³⁶ In other words, the lower the quality of the WE, the less utility will be received by employees, ceteris paribus. This implies that an exogenously induced increase in WE quality (decrease in occupational hazards) will provide employees with a net gain.

In the event that regulations are not a perfect substitute for negotiations, it is necessary to consider two possibilities. Either employers' and employees' organizations would have negotiated to a greater extent than today about the specific form of the WE. Alternatively, they need not have done this. The latter means that the employer will "guess" on the appropriate amount of WE improvements. It does not necessarily imply that less will be spent to increase WE quality, although this does seem likely. In either case it is quite likely that compensation would have been less than complete.

Firstly, the labour market does not work in the smooth and frictionless manner implied by our basic framework. Changing jobs is costly; for example, there are search costs, loss of seniority, costs of moving or commuting, the opportunity costs of human capital acquired, etc.³⁷ This creates a situation where existing employees tend to be undercompensated. This may sometimes be counteracted by the demands of potential employees. However the latter may also face a restricted job choice - the alternative being a costly move to other communities. In addition, it is equally possible that the marginal worker (new entrant) demands less compensation than the already hired workers (cf. the discussion on pp. 74-75). Secondly, employees may underestimate the risks.³⁸ Note that the latter argument implies that employees at the local level underestimate risks, whereas this does not apply or applies to a lesser extent to those who participate in the shaping of regulations.

In general, I would argue that compensation is less likely to be complete if WE characteristics are not explicitly dealt with in the negotiations. Moreover, it is quite probable that this would be the case, since it is inherently unpleasant (in our society) to explicitly trade the health and safety of your fellow citizens for money and other benefits.

Another argument stems from the way in which the costs of complying with regulations are shifted to employees. Again, if costs were immediately shifted to such an extent as to leave the utility of employees unaffected, there would be no disagreement between the parties on the question of regulations. However, it does not work that way.

Wage flexibility is accordingly of great importance for the effect of WE regulations. An often made observation is that wages are inflexible downwards.³⁹ The question is how expected increases in WE quality will affect present wages. This pertains both to expected regulations and to expectations as to the enforcement of regulations at the individual company. The best general picture is obtained by assuming that present wages fully reflect the expected utility of future regulation-induced increases in WE quality. With this perspective, employees and their associations will be in favour of new regulations and in favour of enforcement of existing ones. Every non-expected increase in WE

quality is a windfall gain to employees, whereas every expected increase that does not materialize is a windfall loss. Vice versa for employers. Every windfall gain or loss will subsequently lead to a revision of expectations.

However to some extent wages will probably not be affected by regulations before these are manifested in actual increases in WE quality. Firstly, there is uncertainty about future employment. A future increase in WE quality is of no value to you, if you are no longer employed when it occurs. Secondly, there is a great deal of uncertainty concerning which changes in WE quality will take place at an individual company (and when) as a result of regulations and their enforcement. The fact that individuals have risk aversion implies that present wages will not fully reflect the future utility of increases in WE quality. These two factors suggest that there may be some additional gains to employees from increases in WE quality induced by regulations. However any such additional effect will have to be small, since the long run level of profits are approximately given.

In this case, the initial effect of a WE regulation should be to decrease P_0 (the return to capital), possibly below P_0 ("normal profits").⁴⁰ Note that downward adjustments of wages on short notice generally entail costs, such as production losses during strikes. The provision of certain non-pecuniary benefits is even less flexible. Notably those that entail capital investments, among which there are positively valued WE characteristics. We would expect a subsequent adjustment of wage levels and company expenditure on other non-regulated conditions of work.

At one extreme, companies are directly driven out of existence ($P < \underline{P}$). Next, P may be permanently reduced to a level above $\underline{P}$ but below P_0 . This would have repercussions in the long run. One would expect a fall in output and thus, ceteris paribus, a fall in employment in the affected firms/industries. How costly this is to individuals and/or society depends on the more specific circumstances. Leaving these two situations aside, the question is whether the adjustment process will allow P to reach a higher level than would otherwise have been possible, so that the employer will be fully compensated for the earlier loss. This could not happen in a competitive labour market with negligible search costs and full employment, since this would imply that wages, etc., are below competitive levels, which would leave the company without employees.

We should point out that WE quality as an employment benefit is often technically non-flexible downwards in the short and medium run. It is embodied in the capital equipment. Therefore, an increase in WE quality is a more permanent gain than a wage increase. Employees may find this beneficial.⁴¹ For example, WE quality cannot be varied with the business cycle.

It should also be observed that there is often a deadweight loss associated with re-organizing production to comply with regulations. In other words, there are costs that do not have any correspondence in increased employee welfare. Consequently firms will typically not be able to transfer these costs to workers.

Though none of the competitive conditions are fulfilled in Sweden, I would suggest that workers are more likely to gain than to lose from this whole process. The one exception would be the case where regulation directly cause unemployment. This can happen if firms are caused to stop operating, or if the production is moved to another country. Workers losing their jobs would hardly be net gainers.⁴² Given actual enforcement practices (see section 3.5) this is a relatively unlikely result.

Thus we have established that employees are likely to gain from increases in WE quality induced by regulations.⁴⁴ From our discussion above, it then follows that the regulatory agencies will try to raise the quality of the WE.⁴⁵ We will now turn to the effects of the efforts to increase WE quality through regulations.

3.4 Effects of Regulations in the Case of Full Compliance with Uniform Regulations

We know, of course, that many firms typically do not comply with regulations, and that the Swedish WE regulations do not pose totally uniform demands on the WE in different firms. In addition, we noted above that detected non-compliance with WE regulations seldom leads to legal sanctions. Nevertheless, it is convenient for our analysis to start with the simplifying assumption of full compliance with uniform regulations. This yields a basis from which it is easier to turn to more realistic cases.

As indicated in the previous section, we now assume that the level of WE quality "required" by regulation exceeds the one that would have prevailed without regulation.

From the outset the following should be observed. In studies of regulation, one typically assumes that market contracts are more varied than regulations. We stay within this tradition, thus assuming that labour market negotiations or the guesses of employers regarding the WE would produce greater variety in the demands on the WE than regulations. However we should also note that the collectivized nature of Swedish labour market negotiations (cf. section 5.4) would probably decrease this difference.

Resource Allocation between Industries and Firms

Regulations that impose higher costs on dangerous activities will move resources away from these activities (given that these costs are not totally shifted to employees). This may but need not counteract the tendency of the Social Insurance system to favour high-risk industries. It should be borne in mind that regulations are viewed as a joint undertaking of employee representatives and the "third party". In section 3.3, we discussed different reasons for employees to be in favour of regulations. To the extent that their support depends on less than full compensation and/or under-estimation of risks there is no reason why the effect of the Social Insurance system should be counteracted. One does create a counter-weight to the high-risk industry bias inherent in these two factors. However, if employees make windfall gains (or if there is a relatively limited shifting of costs), the high-risk bias of the WII will be somewhat counteracted.

At the same time, the financing of the legislative and control apparatus out of public revenue represents a subsidy to employees in general, and to those in dangerous activities in particular. (Remember that employees by assumption gain from the increase in WE quality that follows from regulation.) It would seem to me that this will be higher than the cost of participating in the regulatory process. To the extent that the regulatory activity works as a substitute for negotiations, there is an additional subsidy in terms of decreased negotiation costs.⁴⁶ This is a subsidy to both employers and employees.

Regulations can also have other important effects. By increasing the operating costs of existing equipment, it will speed up the structural transformation of an industry, by pushing marginal production units out of the market (Salter, 1966).⁴⁷ The same result would ensue if regulations necessitate new investments. It may also increase the optimal scale of production (an example is given in Jönsson and Lyttkens (1981), ch. 9), for example where some WE improvements are public goods. "There is general agreement that small firms are harder hit by regulation ..." (Ashford, Heaton and Priest, 1979, p. 183).

This means that it may well be to the advantage of new entrants to an industry to push for more stringent WE regulations. New best practice technologies typically embody less negatively valued WE characteristics in a number of respects. By forcing the same WE standards on firms with older capital equipment, the latter can be eliminated. This will allow new entrants to gain a larger share of the market.

While a more rapid rate of structural transformation can be advantageous from a WE point of view (though there are risks too, cf. Chapter 4), it may also bring problems (cf. Jönsson and Lyttkens, 1981, ch. 9). In particular, it may increase unemployment. How costly this would be to society depends on a number of factors. However this is not the place to dwell on such issues.

WE regulations can also influence what happens "at the other end" of the market - the new firms. If WE regulations increase the fixed cost of production and/or the optimal scale of a production unit, it may make entry into the industry more difficult. Entry also becomes more difficult when (as in Sweden) more stringent demands can be made on new establishments (Maloney and McCormick, 1982).

There is another totally different way in which the demands on the WE can be used to protect an industry from competition. This is the suggestion to include "social clauses" in agreements on international trade policy. In other words, certain WE standards would be specified in such agreements. "Countries that do not comply with the minimum requirements [...] run the risk of being confronted with increased trade barriers in their export markets." (G. Hansson, 1983, p. 11) How this can be used as a trade barrier is analyzed by G. Hansson (1983), who also finds that they are a dubious measure of solidarity.

We have thus seen that regulations can be "used" as an instrument to restrict competition. This is important in the case under consideration, but is obviously of greater interest in the case of variable product prices, which we will deal with in section 3.6.

It is a well-known argument from the economics of regulation (see for example Stigler (1971; 1975))⁴⁸ that regulations in fact can be to the advantage of the regulated (as restriction of competition or otherwise). For this to be the case, it is normally necessary that the regulated industry exerts an influence on the decisions of the regulatory bureaucracy.

It need not be debated that the regulated activities influence the regulatory process in Sweden. As we saw in section 3.1, existing firms and their employees are well represented in the decision process.

I do not suggest that the regulatory process is used strategically in the competition between firms and industries. However, one must admit that the possibility exists. What one could say is that the interest of potential firms and their would-be employees is less likely to be taken into consideration. Kelman (1981b, p. 233) conducts the same argument with regards to newly emergent groups. The first duty of the representatives of employers and of employees will be to protect the interests of existing companies and their employees. Moreover, ASS officials are probably more interested in cooperation with existing companies than in the emergence of new ones. Thus, would-be firms would not be better than a 2-9 minority on the board of the ASS. The same is the case for groups of consumers, who might suffer if WE regulations led to price increases, a possibility which will be considered in section 3.6.⁴⁹

Resource Allocation within Firms

In Chapter 2, we mentioned the well-known feature of uniform regulations that some companies will choose a socially inefficient level of prevention activity.

In addition, regulations will affect the cost structure of the production process in an unpredictable manner. Depending on the effect on marginal costs and on the value of marginal product of labour, in the long run, both output and employment may increase, decrease, or remain unchanged.⁵⁰ Again, any individuals losing their jobs would hardly benefit from the regulation. Viscusi (1983a) also shows that if penalties are linked to the existence of non-compliance, foreseeable changes in regulatory policy towards more stringent standards (higher penalties) would cause firms to choose a lower employment level (activity) today. (Uncertainty concerning the stringency of regulatory policy would tend to further depress employment levels.)

No further discussion is required on the effect of regulations on short run WE decisions, since WE quality is assumed to have increased. Before leaving this subject it should be noted that it is quite possible that regulations may not to any great extent counteract the lower level of prevention activity that is generated by the Social Insurance system. The same arguments as regarding allocation between firms and industries applies here (see above).

Ashford et al. (1980) has suggested that an important effect of regulations (perhaps the most important) is the leverage effect on technological development. There are two effects here. Firstly, employers will take account of the regulation of future hazards. Hence these future hazards will exert a greater influence on the development of new technologies. Secondly, by compelling firms to develop new technologies that embody less health risks, etc., the technological path of society is altered.

The first effect counteracts the tendency of the Social Insurance system to bias technological development towards more risky processes, machinery, etc.

The second effect hinges on the fact that the market for technological development is undoubtedly far from perfect. (To draw the welfare implication that such a change in technological development is desirable is another matter. Among other things this requires that the demand for health and safety is relatively difficult to express via the market. This may well be so, as we will discuss below.)

The above may be used as an argument to provide employees with more safety and health than the currently expressed demand. Whether such changes could occur in the Swedish system will be discussed below. (N.b. this would go against the wishes of both employers and employees.)

The Individual Employee and the Employment Contract

By assumption, employees will gain from the increase in WE quality that compliance with the regulations ensures.

However these benefits are not distributed evenly. It was argued above that employees in industries with low quality WE would receive the greatest gains, ceteris paribus. The differences do not end there. Regulations may provide employees with more or less WE improvements than they would have bargained for on a voluntary basis. (Or exactly the same amount, but that is an unlikely outcome.) The term "bargained for on a voluntary basis" indicates the amount that the employees

would have bought privately given frictionless markets and full information. Thus, if they actually receive a greater amount, and are required to pay for it, a welfare loss is implied. It is necessary to have a further look at this case of over-provision.

In the absence of regulation, we would expect negotiations to produce a relatively safe and enjoyable WE in firms where the cost of achieving this environment is low, and vice versa. In contrast, regulations in principle impose uniform intra-industry standards, and generally decrease risk levels in the economy. If regulations (decisions at the ASS) can be implemented at the local level against the wishes of both employer and employees, this implies that workers in high-risk firms and/or industries will enjoy a better WE than they would be willing to "pay for". Accordingly their gain from regulation would be reduced to the extent that they have to pay an amount in excess of their valuation of WE improvements (through decreased wages, etc.). It might even be turned into a loss. In particular, this may happen to individual employees or small groups of employees in a company, that may be "overruled" by decision-making bodies at the local level. The ability to cope with and aversion to risk varies between individuals. Viscusi (1983b, pp. 45-53, 83-84) emphasizes that regulations will decrease the utility of poor workers most, since they are the most willing to take high-risk/high-pay jobs.⁵¹ A similar argument is put forward by Nichols and Zeckhauser (1977).

There are also gains of a more intangible nature for employees in dangerous WE that arise from the public control apparatus (and thus indirectly for their employers). To protect themselves from injuries, workers need to control not only the employer, but also each other. In many surroundings, employees face a substantial risk of being injured through the actions of fellow workers.

The required mutual control can be exercised by: 1) themselves, 2) the union, 3) the company, or 4) a public authority. In the first two cases the control is paid for by the employees, and the same is also largely true of the third case. It is, however, not this cost aspect that I wish to emphasize here, but rather the psycho-social aspects of the WE. The first three control methods share the same detrimental effect. Considerable bad feelings could arise if employees had to go around checking on each other. The same holds though to a lesser degree when the control is exercised by their elected representatives, or by their superiors.⁵²

It was emphasized in Chapter 1 that the psycho-social factors are extremely important for our valuation of the WE. Hence the fact that both regulation and to a large extent control are removed from the work site constitutes an important improvement in the WE. With regards to particular regulations, both the employer and safety representative are able to refer to (or blame, as the case might be) the legislator. In addition, control is largely taken over by the YI.

The safer the WE - the less need for such mutual control by employees. This constitutes an additional benefit from the WE improvements in this vein.

The increase in WE quality also means that the composition of the employment contract changes. So far we have only considered that the contract may be such that there is in total "too little" compensation for negatively valued WE characteristics, in the sense that employee utility is not equated between different employments. We now consider the mix of the "individual" contract. There are a number of factors that influence the composition of the employment contract, in such a way that the employee's marginal utility varies for different kinds of company expenditures. The implications for the effect of regulations depend on whether the level of employee utility is also affected.

The basis for many of these arguments is that major changes in WE quality generally entail capital investments. This has two implications. Adjustments of the employment contract will often have to take other forms, such as wage increases. For example, a marginal increase in WE quality in response to the changed preferences of the employees may be very costly. Secondly, the benefits from a capital investment that raises the quality of the WE will accrue over a long period of time.

This aspect of WE determination leads to the conclusion that changes in institutions and/or the value structure of society will generally produce a "sub-optimal" mix in the employment contract. A number of such changes appear to have increased the relative attractiveness of WE improvements in the post-war period: changes in taxation (Ståhl, 1972), rising real incomes, changes in information and basic value structures. We will discuss these in turn.

Marginal tax rates have increased considerably during recent decades. I. Hansson (1983) has estimated the total marginal effects of the taxation and transfers system (personal income tax, payroll tax, etc.). His results are presented in Table 3.2. Note that this calculation includes less than half of the payroll tax (the rest being considered to be a fee). If the whole payroll tax had been included the increase in marginal tax rates would have been significantly greater.

Table 3.2: Average total marginal effect of the taxation and transfers system for different real incomes, 1980 prices

income in SEK:	average	30,000	60,000	90,000	120,000
year:					
1950	-	37.0	44.4	47.0	51.2
1955	40.2	37.9	45.3	49.4	52.0
1960	47.9	47.2	55.0	58.4	59.5
1965	55.3	53.1	59.3	62.3	63.6
1970	62.3	64.0	68.3	67.0	68.1
1975	69.6	59.2	69.1	73.6	74.8
1980	72.4	61.8	70.2	80.8	85.5

Source: I. Hansson (1983), Table 3, p. 22.

This increase in taxation has diminished the individual's valuation of company expenditures on wages and other taxed benefits at the margin. This effect ought to be even more marked, ceteris paribus, for workers who have low quality WE and correspondingly high compensation. At the same time, rising real incomes have increased the demand for WE quality.

It is also likely that information regarding the potential danger of various WE characteristics has tended to increase relatively during this period. At the same time, rapid technological development during this century carries the implication that individual employees become less and less well-informed concerning their occupational hazards. In contrast, the age-old traditions of the pre-industrial society supplied much of this knowledge. This implies that regulated increases in WE quality have tended to become more popular.

Finally, there may have been a more fundamental change in the value structure in society. For example, Lyttkens (1982) notes that in the absence of religious beliefs, our society turns its expectations for "the good life" towards the present. All factors that conflict with the present day "ideal" is met with increasing uneasiness. He also suggests that for example our concern regarding a nuclear war may be transferred to other areas (over which we have more influence).

The trends discussed above will all have decreased employee utility from a given employment contract. In a frictionless world with no indivisibilities, WE quality would have been raised in response. However, as argued above, such an increase may prove to be highly costly for the company in the short and medium run. The immediate solution might therefore be to increase other expenditures to the benefit of employees. What are the implications?

As noted in the previous section, compensation may be "too small". It may be added in the present context that compensation will have become increasingly costly because of the trend in taxation (cf. also Chapter 5).⁵³ If compensation is "too small", the previously examined case where employees gain from regulations applies. If compensation is not inadequate employees may still gain, because of a less than complete shift in costs, as explained in the previous section. As long as the costs of WE improvements borne by employees do not exceed their valuation of these improvements employers will certainly lose. Even if regulations do not result in a change in employee utility, they may be in favour of them because of the perceived "sub-optimality" of the contract mix.

There are two more "distortions" of the composition of the employment contract that require consideration. Firstly, as will be more extensively discussed in Chapter 5, characteristics of the bargaining system in the labour market may affect the composition of the employment contract. The collectivization or other features of labour market bargaining may lead to a relative over-provision of pecuniary benefits and an under-provision of WE improvements (cf. Chapter 5);⁵⁴ signals between the parties are not interpreted correctly, elements of the bargaining procedure tend to produce the "wrong" result, etc.

This introduces an element that in itself can lead to gains from regulations for both employers and employees. The outcome depends on how the benefits from the improvement of the contract mix are distributed. These effects should then be added to the other ones discussed in this section. It is conceivable that as a result both parties gain ex post from the regulations. However I consider this to be unlikely.

Secondly, we shall now consider the implications of an underestimation of safety and health risks by workers. If workers underestimate these risks, they would tend to bargain for too few WE improvements. The composition of the employment contract would thereby not be optimal from their point of view. They would also accept an employment contract which gives a lower utility level in dangerous industries than would have been the case with correct estimates. It is assumed here that the perception of risk is corrected by the regulation. (The case of employees who are not in favour of regulations ex ante is discussed in the next subsection.)

Regulations will then cause a change in the proportion of WE improvements versus other benefits, to one that provides a better reflection of the correct risks of occupational injuries. Employees would also demand higher compensation. The effects of such changes has already been analyzed above.

Increasing Work Environment Quality by Coercion

We shall now consider two related problems. Both concern the question of giving people higher WE quality than they would be in favour of ex ante.

First we consider the possibility that the AML can be used to enforce higher levels of WE quality against the wishes of both employers and trade unions. Given the fact that the state provides the whole apparatus surrounding the decision-making boards (as well as the inspectors), it is perhaps conceivable that this could happen.

One can identify a number of reasons why such efforts might be made. It may be wished to counteract fully the negative effects of the Social Insurance system on the provision of preventive measures and on resource allocation between industries and firms. As we have seen, this may not occur in the previous cases. As a result of the Social Insurance system some effects are external to the parties on the labour market. In Chapter 2 we observed that an important part of injury costs are not borne by either party. Therefore, WE improvements that are beneficial to society may exist, even though neither party would be in favour of them if they were correctly informed (Skogh, 1977a). (In the sense that they would have desired the improvement if they had borne the full injury costs.)

There are also "paternalistic" arguments - that employees will be better off if they are provided with higher WE quality than they currently think that they need. The most obvious one is that employees (their representatives) may continue to underestimate occupational hazards, in spite of regulations, public information, etc. It should be pointed out that the regulation of risks may give employees a "false feeling of safety". Regulations can never cover all risks.⁵⁵ Hence an official policy of providing a "safe and healthy" WE (without qualifications) may lead to an under-estimation by workers of non-regulated risks. In a similar way, workers may think that regulated risks are totally eliminated. This is seldom the case.

If employees bear the cost of WE improvements that are forced upon them, and where the justification for this is the "paternalistic" kind of argument, the welfare implications for the individual become problematical to assess. The ex ante utility of all individuals would be lowered in this case. The only ones to benefit would be those individuals who escape injury or are less severely injured, as a result of the regulations. All other employees would also have their utility lowered ex post. These issues will be more extensively discussed in Chapter 6 and Appendix 3.

As noted before, one may also wish a change in the path of technological development followed by society, as noted before. (If this argument is couched in terms of choices open to future generations, for example, it would not necessarily carry the distinction "paternalistic".)

It may be the case that a safe and healthy WE is the subject of merit wants. In other words, it is considered desirable that the authorities force upon us a safer WE than we would ourselves privately choose.⁵⁶

We should also remember that there is a positive income elasticity of demand for health and safety.⁵⁷ This means that if the regulator has a higher income than the employee and "extrapolates" his/her own preferences to the employees concerned, this tend to lead to an over-supply of WE improvements through regulation (Viscusi, 1983b, pp. 51, 80). Such could well be the case, for example, if it is the preferences of Members of Parliament that permeate the regulatory process.

Finally, the nature of their function may induce both politicians and regulatory officials to tend to oversupply health and safety at the workplace. Politicians are elected to govern the country. A healthy and safe life are likely to be among the most important wishes that politicians have with regards to their constituents. One should not be surprised if they become overambitious, or that they use measures such as regulations to achieve their goal.⁵⁸ Regulatory officials in their turn are employed for the (generally declared) specific purpose of improving WE quality. In addition, WE improvements are tangible benefits. The cost to the employees are seldom equally obvious (except in the case of business closure).

The second question in this subsection concerns disagreement between different decision levels among employees. There are three levels: the ASS, the YI, and the workplace. "Higher" levels (in cooperation with regulatory officials) may impose undesired WE improvements on the lower levels. This is probably easier than for officials operating on their own. All the paternalistic arguments from the previous case apply here too, mutatis mutandis. Higher incomes among trade union officials than among their members could produce a similar tendency.

Summary of Effects

It is now time to summarize the effects of WE regulations under the assumptions of full compliance with uniform standards. This will change the composition of the employment contract.

If employees underestimate the risk they face or are undercompensated, high-risk industries will be favoured. Regulations will counteract this tendency. The same may hold to some extent for the cost-externalizing properties of the public insurance system discussed in Chapter 2.

The public financing of the regulatory process entails a subsidy to employees, in particular to those in highly regulated activities. To the extent that negotiations are being substituted for, an additional subsidy to both parties is implied.

It was noted with regards to inter-firm relations that regulations usually speed up structural transformation. We also found that regulations can be used to restrict competition. Furthermore, the composition of the board of the ASS as well as the design of the regulatory process made such strategic behaviour possible. In particular, we argued that the interest of potential firms (and their would-be employees) and of consumers is less likely to be taken into consideration.

In accordance with our assumptions, WE regulations lead to higher levels of WE quality in (some) companies. They also affect technological development. Once again, the discouragement to prevention that results from the Social Insurance system may be counteracted. However this is not necessarily the case.

The problems of inefficiency that arise to the extent that more uniform demands are created by regulations have been discussed in Chapter 2.

By assumption, employees in principle gain from the regulations. However, there are inter-employee differences. It has been seen that groups of employees (in particular poor and/or less averse to health and safety risks) may be "subjected" to a better WE than they would have wished to pay for.

We also noted that the psycho-social aspect of the WE will improve when employees have less need to control their fellow workers.

For a number of reasons, the composition of the employment contract may not fully reflect the relative contribution at the margin to employee utility from different kinds of expenditure. This strengthens the argument that employees will gain from regulations. It is possible that there may be ex post benefits for employers as well.

Finally, an improvement in the WE beyond the voluntarily chosen level may be desired. This may be due for example to the effects of the Social Insurance system mentioned above or to paternalistic attitudes. The policy of WE regulations may create this opportunity.

We have dwelt fairly extensively on the effects discussed in this section. This is because they will be used as a starting point and frame of reference for the rest of the analysis in this chapter.

3.5 Work Environment Regulations with Partial and Negotiated Compliance

It has frequently been noted by economists that there is no a priori reason for firms to comply with cost-increasing regulations. Instead it is argued that they will comply only to the extent that compliance is less costly (more profitable) than non-compliance.⁵⁹ Furthermore, detection of non-compliance is generally incomplete, since full detection is prohibitively costly. Work sites are only occasionally inspected and violations may only occur at certain times. Moreover an inspector cannot be expected to detect all of the non-compliances during an inspection.⁶⁰ The relevant comparison is therefore with the expected cost of non-compliance, which is the product of the

probability of detection and the (expected) penalty when detected. (The latter may be thought to include loss of goodwill, etc.)

Economic studies of WE regulations based on such reasoning has followed two main lines. One is to determine the (theoretically) optimal standard to be set by regulation (Viscusi and Zeckhauser, 1979), or the optimal detection rate and/or fine (Polinsky and Shavell, 1979; Skogh, 1982).

It is found (Viscusi and Zeckhauser, 1979) that setting more stringent standards may lower the average safety level, ceteris paribus. Although a tighter standard leads to increased safety in complying firms, it will also tend to increase the number of firms that find it too costly to comply. Increasing the magnitude of fines may appear to be the logical answer to the problem of inducing maximum compliance.⁶¹ However, this does not necessarily apply when the fines are of such a magnitude that the offending company displays risk aversion (Polinsky and Shavell (1979), Skogh (1982)). Skogh notes that a risk-averse injurer may decrease safety precautions in order to be better off in the case of detection and punishment. Polinsky and Shavell focus on the injurer's decrease in utility as a result of risk bearing.⁶² While we have assumed that firms are risk-neutral with respect to any moderate costs, this may not be the case with fines that jeopardize their existence. Moreover, the welfare loss of the workers entailed in the closing down of a firm should be taken into account. In addition, Viscusi (1979b) found that in extreme cases (severe punishment and/or very stringent enforcement), regulatory efforts may become counter-productive (safety decreasing) because workers reduce their safety precautions. The existence of this counter-effect is also noted by Mendeloff (1979, p. 92).⁶³

The other line of investigation consists of empirical studies of the effect on the health and safety of workers of the WE regulations and of the subsequent control measures. Studies of the Occupational Safety and Health Administration (OSHA) suggest that it has at best had a very small impact on injury rates (Bartel and Thomas (1985), Chelius (1974), Cooke and Gautschi (1981), Mendeloff (1979, ch. 6), Nichols and Zeckhauser (1977), Smith (1976, pp. 67-70, app. C; 1979b), Viscusi (1979b; 1983b pp. 32-36)).⁶⁴ It is also clear that this lack of impact may be due either to the low level of expected penalties,⁶⁵ and/or to misdirected regulatory and enforcement efforts,⁶⁶ and/or to injuries not being preventable by existing regulatory procedures.⁶⁷

While the studies discussed above have yielded a number of important insights, there results are nevertheless of limited value for a study of the Swedish experience.⁶⁸ This is because Swedish WE regulations are not enforced, as we saw in section 3.1, in the way assumed in these investigations. Instead of legal sanctions, the enforcing authority (in our case the YI) usually resorts to negotiations and persuasion. Furthermore, the regulations are generally not totally specified, but are left to the YI to interpret in each specific case. Regulations are not applied uniformly.

We will now discuss the structure of actual enforcement and regulatory practice in Sweden. In the light of this discussion we will then reexamine the conclusions drawn in the previous section.

Enforcement Strategies in Sweden

Following the example of Fenn and Veljanovski (1984), we will now try to outline a positive theory of regulatory enforcement. This is a prerequisite for a satisfactory understanding of the effects of regulation. Fenn and Veljanovski present the enforcement problem as a bargaining game between the inspectorate and firms.⁶⁹ We adopt the same starting point, and try to develop a model that reflects the Swedish situation. As in the model of Fenn and Veljanovski, negotiated compliance will be seen to constitute a potentially optimal strategy for the YI, given the rules of the enforcement system.

A peculiarity of the Swedish system is that firms that are found to have an unsatisfactory WE cannot normally be punished immediately. This is partly a consequence of the non-specified nature of many regulations. Non-compliance presupposes a judgement by the YI in the specific case. Punishment is only possible when firms have refused to comply with the decisions of the YI. This has two important implications. First, firms are likely to adopt a strategy of let's-wait-and-be-inspected. There is very little incentive to implement WE improvements prior to inspection. This can only be expected when firms expect inspection and at the same time compliance before inspection is sufficiently less costly than after. (To cover the expected opportunity cost of capital for the period between compliance pre and post inspection.) Thus, high WE quality can be expected primarily for new large installations where ex post compliance would prove to be costly.⁷⁰ Secondly, an important benefit of legal sanctions in the model of Fenn and Veljanovski is the general deterrent effect that such measures have, i.e., a positive effect on the preventive activities of firms not yet inspected. In the Swedish system, there is no such effect.⁷¹ In its choice of strategy, the YI need therefore only be concerned with obtaining compliance from the individual firm (see below).

Another important feature is the possibility that firms are not required to achieve the same WE quality in all respects, within the life-time of existing capital equipment. Such local variations in the WE will arise inter alia if and when the YI takes the cost of compliance into consideration. These costs usually vary between firms.⁷²

Consideration of costs are to a certain extent sanctioned by Swedish law. Such possibilities are not mentioned in the wording of the AML proper. However, the government bill and other preparatory work indicate that costs of compliance may be taken into consideration.⁷³ On the one hand, the effort should not be "unreasonable" in relation to the expected benefits. More stringent demands can be made on new establishments than on old ones. Other conditions may also lead to less stringent demands. For example, although consideration should not be taken of the local employment situation this will in practice probably occasionally take place. On the other hand, tests of the reasonability of the demands placed on the WE ought not to be the rule. Thus, the legal situation is in this respect undoubtedly somewhat ambiguous. What seems clear, however, is that costs are actually taken into account by the YI (cf. Lundberg (1982) and Kelman (1981b, pp. 187-188, 191)).

Fenn and Veljanovski (1984) assume that, given their budget, the inspectorate minimizes the social harm of the activities they control. In addition, it should be noted that the safety inspectors themselves prefer a pleasant WE, and that meeting hostile people is detrimental in this respect.⁷⁴ Lundberg (1982, p. 173) suggests that this might exert an influence on the behaviour of inspectors. This is also borne out by the findings of Kelman (1981b, p. 214).

Before we proceed further, it might be suggested that this may be considered rather an uncritical view of the behaviour of the YI. It might be more in line with the economic framework in this study to assume that the YI maximizes its own utility. This may involve highly different incentives, such as the straightforward tendency to do the job you are hired for (Kelman, 1981b, p. 186), to maximize the number of inspections, etc. We will not discuss these other motives further. Nor will we study the relation between the ASS and the YI, or between these agencies and parliament.⁷⁵ Obviously, there is a principal-agent kind of problem at each level.

Let us now consider the situation when the YI has decided that a company should make WE improvements. For the moment we leave aside the effects of local variations in the WE permitted by the YI. The YI has then two options, which can be termed, using the terminology of Fenn and Veljanovski, the penal and the negotiated compliance strategies.

The penal strategy consists of issuing an order or a prohibition to the company. Continued non-compliance would then lead to punishment of the firm.⁷⁶ From the point of view of the YI, there are six problems connected with this strategy,⁷⁷ viz.:

- 1) The company may lodge a protest against the order or prohibition, thus delaying the point in time when it acquires legal force.⁷⁸

- 2) The company may ignore the order/prohibition even when it has acquired legal force, if it considers that the cost of compliance exceeds the cost of the punishment (including penalties, loss of goodwill, etc.).

- 3) The company may try to circumvent the order/prohibition in some way. For example, a dangerous part of the production process may be sub-let to another company e.g. one created by the same employee(s) as would otherwise have performed the task.⁷⁹

- 4) The company may make the next visit by the inspector more "difficult", by withholding or not volunteering information or generally being as obstructive as possible within the limits of the law.

- 5) The company officials may react with hostility towards the inspector personally. This means that the inspector will be working in less pleasant circumstances.

- 6) It may well be more costly⁸⁰ (this will be discussed below).

The other possibility open to the inspector is the strategy of negotiated compliance. This entails trying to persuade the company into compliance, or just telling them what to do without resorting to legal sanctions.⁸¹ Finally, if the company refuses to comply even after the negotiations, the YI will have to fall back on the penal

strategy (in which case it would obviously have been better to adopt it from the beginning).

Enforcement as a Bargaining Game

As already indicated, the approach of Fenn and Veljanovski (1984) in viewing the enforcement of WE regulations as a game is adopted here. This also accords well with Lundberg's (1982) description of the enforcement process in Sweden. The outcome depends on the actions of both players (company and YI). In their strategies they must take account of the options open to the other party. It is important to note that the players do not act simultaneously. Instead, the YI has to announce its choice of strategy, upon which the company will make its choice. It will generally not be possible for the YI to determine beforehand which strategy would lead to the quickest compliance.

First, we must consider why the firm has an unsatisfactory WE. The "traditional" answer would be "profit maximization". However, as argued by Fenn and Veljanovski (1984) and Veljanovski (1983a), it is eminently possible for firms to be in this situation because of ignorance or incompetence. These two cases can be treated together, because they share the same basic features: since the present state was not the actual intention of the firm, the YI can achieve WE improvements simply by transferring information of one kind or another to the company. (If the firm had had full information on standards, prevention technology, etc., the WE would have been better. Of course, there can also be cases where the firm is ignorant, but where this would not have made any difference in the WE decisions. Analytically, these cases belong to the group of intentionally bad WE.)

Now, if the YI knows for certain that it is dealing with such non-intentional unsatisfactory WE conditions, it seems reasonable to suggest that a transfer of information will be the preferred strategy. This is one variant of negotiated compliance. The firm would then by assumption improve the WE. Of course, the penal strategy is one way of making it known that the WE is unsatisfactory which may yield quicker results. On the other hand, the YI then runs the risk that the employer chooses 1)-3) above, rather than meeting the cost of acquiring information on prevention technology, etc. Even if this does

not happen, there are disadvantages of type 4)-6) to be taken into account.

If the state of the WE may have been intentional on the part of the company, the case becomes more complicated. Once inspected, the company has two objectives: to delay compliance and to avoid being punished. The YI wishes prompt compliance, and if possible the avoidance of problems 4)-6) of the penal strategy. However, let us forget about points 4)-5) for the moment.

The payoff matrix then has the following appearance. The first figure in each square shows the outcome for the YI, the second for the company. P is the return to capital. For the firm, the cost of compliance is c , and the cost of punishment is v . This should be thought to include all the costs of being convicted, including lawyers' fees, loss of goodwill, etc. The punishment may be a fine, imprisonment, or a penalty. The first two are set by court, while in principle the YI sets the penalty when issuing the order or prohibition (but see below).

		reaction of the firm	
		compliance	non-compliance
YI strategy	penal	(1, $P-c$) after time t_1	(0, $P-v$)
	neg. compl.	(1, $P-c$) after time t_2	(0, P)

t_1 is the maximal time during which the company can delay compliance, when it is subjected to the penal strategy. t_2 is the time that elapses before the negotiations result in compliance.⁸²

Conditional on the reaction of the firm, the YI receives the same payoff under both strategies, assuming that the enforcement cost for the YI is the same for the different strategies. The ASS states that the penal strategy is more costly for the ASS and the YI combined.⁸³ However if this is so, it is not self-evident how this would influence the choice of strategy of the YI. (Note that the YI bears the whole cost of negotiations, while the costs for the penal strategy is split

between the YI and the ASS.) In the absence of definite empirical studies, we will consider both the possibility of equal enforcement costs, and that the penal strategy is more costly for the YI. In the system analyzed by Fenn and Veljanovski (1984) the higher cost of the penal strategy plays an important part in the trade-offs for the inspectorate. In particular, using the penal strategy then entails a sacrifice in terms of fewer inspections.

To simplify the analysis, we adopt equal costs as the basis for our analysis, and observe how the results are affected if the penal strategy is more expensive.

Note first that if $v < c$, then the company will always choose non-compliance. The choice of such a penalty can never be intended by the YI. Nevertheless, it may occur that v becomes smaller than c . The penalties set by the YI are often substantial. However, these are consistently lowered in court; mainly because the company complied on some of the points included in the order/prohibition, or because it complied at the time of the sentence (imposition of the fine) though not at the time ordered by the YI. In 1981-1983 the fine included in orders/prohibitions that went to court varied between 10,000-200,000 SEK, with a median around 40,000 SEK. The ten (out of fifteen) fines that were imposed were in the magnitude of 2,500-25,000 SEK, with a median of 5,000 SEK. This state of affairs implies an additional possibility for delay. Especially if this is well-known to firms.

Now, only about 30% of orders and prohibitions are issued under the penalty of a fine.⁸⁴ In the other cases, the punishment consists of a fine and/or imprisonment decided by the court. It is important to note that the culprit in these cases is an individual, not the company. In practice, the punishment will be a fine (during 1981-1983 there is only recorded one sentence of imprisonment).⁸⁵ These fines are notoriously low. Normally, they fall within the range of 0-2,500 SEK (84% of fines in 1981-1983). Only about 10% of them exceeded 3,000 SEK (the average fine in 1981-1983 was 1,600 SEK). Skogh (1977a) suggests that the fine will in effect be paid by the company, since the "guilty person" usually occupies a senior position in the firm.⁸⁶ To the extent that this happens, the deterrent effect of a fine of less than 3,000 SEK is likely to be small.

If the YI strongly suspects that $v < c$, then one option is to use the penal strategy and establish the guilt as quickly as possible. This would be in order to obtain a more severe sentence in a "second round". However, this process will take considerable time. Once the penal strategy is chosen, the YI have no means by which to influence the decisions of the company other than by the potential sentence of the court. Meanwhile, the situation for the firm as concerns new capital investments may change, so that c is lowered. It is therefore conceivable that the YI will not in this case adopt the penal strategy.

The tendency to choose negotiations will be more pronounced if the penal strategy is the more costly one.

The case where $v > c$ requires more careful analysis. If the YI knew for certain that $t_1 < t_2$, then the penal strategy would be chosen. The company would then be forced to choose compliance, which maximizes the payoff for the YI.

However, t_2 is not known. It is controlled by the company. What happens is the following. The YI will base its choice of strategy on the expected returns. One option is to use the penal strategy, thereby indirectly informing the company that its WE is unsatisfactory. This can ultimately lead to three different results: 1) immediate compliance (see below), 2) compliance after t_1 , and 3) non-compliance established as the "final" result after t_1 (which will start a new round).

The other alternative for YI is to inform the company about its unsatisfactory WE and start negotiations. There are then four possible final results: 1) immediate compliance (see below), 2) negotiations lead to compliance after t_2 , 3) negotiations do not lead to compliance, the penal strategy is adopted, and compliance is obtained after $t_3 + t_1$, where t_3 is the time spent in futile negotiations, and 4) negotiations do not lead to compliance, the penal strategy is adopted, and non-compliance is established as the "final" result after $t_3 + t_1$.

Immediate compliance is possible for the following reason. The company may have been unaware of the true state of affairs. Therefore, it may prove strictly cost-saving for the firm to comply, i.e., P does not necessarily decrease. Though such WE improvements fall outside the scope of our study, this possibility must be included in the analysis on this point.

We can write the expected utility of the penal strategy with assessed⁸⁷ probabilities r_i

$$r_1 U(\text{immediate compliance}) + r_2 U(\text{"penal" compliance after } t_1) + \\ + r_3 U(\text{non-compliance established after } t_1).$$

Similarly, the expected utility of negotiated compliance is given by

$$r_1 U(\text{immediate compliance}) + \\ + r_3 U(\text{non-compliance established after } t_3 + t_1) + \\ + r_4 U(\text{compliance agreed upon in negotiations after } t_2) + \\ + r_5 U(\text{"penal" compliance after } t_3 + t_1)$$

where t_3 is the time that elapses before the YI changes strategy to the penal one.

We make the assumption that the assessed probability of immediate compliance and of non-compliance as "final" results are the same for both strategies. If negotiated compliance is chosen, it is because the attractiveness of actually negotiated compliance outweighs the delays (deterioration) in the alternatives "penal" compliance and established non-compliance. It is always in the interest of the company to seek to persuade the YI to choose negotiations initially. (For example, by suggesting that t_2 will be short.)

Suppose the YI chooses negotiations. The company will then choose between compliance and non-compliance. This choice will depend on the expected returns from compliance and the expected returns from non-compliance. With the present model, the latter would always exceed the former if this was a one-off game. (Note that the company will never actually be penalized, unless $v < c$.) However, the longer it takes for the firm to comply, the greater the probability that the YI will choose the penal strategy immediately the next time. This is a source of disutility (decreasing profits) to the company. Both the initial choice of strategy of the YI and its subsequent considerations will be

affected by company behaviour with respect to previous complaints. At least for large firms, this is not a one-off game. At the same time, previous strategy choices by the YI act as signals to the companies.

If the company remains non-compliant, the YI will have to make a new choice of strategy. Compared to the previous one, the penal strategy is more likely to be chosen.

Several factors contribute to this change. Non-compliance implies that the firm have a large c and/or a small v .⁸⁸ This would increase r_3 (r_1 now equals zero), which is more detrimental to the negotiation option, since the outcome associated with that probability is worse than in the penal strategy. In addition, t_2 could be expected to be longer. For each period, non-compliance may also be deemed increasingly unacceptable. This may increase the attraction of doing something definite about it - that is, the penal strategy.⁸⁹

If the YI again chooses negotiations, the company faces a new choice. It is now more probable that it will comply. If the company still does not comply, it is up to the YI again, etc. etc.

This process may converge upon a solution of negotiated compliance. Alternatively the penal strategy may be chosen somewhere along the line. The latter may happen because of the uncertainty that exists concerning the situation of the other party. (A similar result to the one derived here would ensue if the adoption of the penal strategy in itself would be detrimental to the company.)

One way of modelling this process would be as a negotiation over t_2 between the YI and the company. In this way the sequential nature of the problem is ignored. The conflict point is given by the penal strategy. The existence of disadvantages 4)-5) of the penal strategy and/or the greater expense of the penal strategy means that for $t_1 = t_2$, the YI will prefer a strategy of negotiated compliance. This implies that there is a range of values for t_2 , such that negotiated compliance (time t_2 ensuing before compliance) is preferable to both parties, in relation to the YI choosing the penal strategy.

In conclusion, we find that negotiated compliance may often be an optimal strategy for the YI, given the institutional setting. This is hardly surprising. For example, Fenn and Veljanovski (1984) also derived this result, and in relation to their model one of the main advantages of the penal strategy (the general deterrence) is absent in the Swedish system.

Local Variations in Work Environment Quality - Non-Uniformly Applied Regulations

We now return to the possibility (see above p. 116) that the YI allows local variations in the quality of the WE. This means that the negotiations with the employer are extended to include the size of c . There are several reasons why the YI may want to allow such variations. The most obvious is that full compliance may at the margin produce more costs than benefits. (This is stressed as an efficiency enhancing feature of negotiated compliance by Fenn and Veljanovski (1984) and Veljanovski (1983b).) Furthermore, social harm may decrease if the YI is able to trade a decrease in c for a speedier compliance. Lowering c will also make it less likely that the firm refuses to comply. By being "understanding" the YI will presumably also create a more friendly and cooperative atmosphere.

Thus, both strategies considered above entail the option of allowing local variations in the WE. This has certain consequences in addition to those stemming from the nature of the bargaining game.

One consequence of allowing variations in c is that this makes it less likely that companies consider WE factors when planning for the future. To a certain extent, the YI can mitigate this tendency, since it is consulted in the planning of new establishments. However this can never fully counteract the fact that companies have less incentives to prepare for future WE regulations in their research and development.

A problem for the YI is that companies have an incentive to overstate the cost of compliance in this case.

The inefficiency entailed in uniform regulations will be mitigated to the extent that the costs and benefits of WE improvements are correctly estimated and taken into consideration (cf. section 2.3). The variations in compliance can probably partly be described as having a cost-benefit character. However, this hardly goes further than, for example, making stringent demands in the case of obviously large risks for occupational injuries, and more lenient attitudes to "comfort factors".⁹⁰ There is no way of knowing if the benefits from these different WE improvements are correctly weighed against (social) costs. Even if it is assumed that the YI does have a correct perception of the costs of compliance, no comprehensive guidelines exist for the valuation of these risk-reductions and other WE improvements.

It may be observed that if full advantage is to be taken of this enforcement procedure, regulations must be set accordingly.⁹¹ In particular, regulations must be stringent enough to force the least-cost firm to its optimal prevention level. The demands could then be relaxed in varying degrees for other firms. For example, in relation to carcinogens the simplest method may be to set the standard at zero exposure, and then allow departures from this level. In particular, there would be no place for consideration of costs in standard setting, except to ensure that the most cost-effective firm will be forced to the correct prevention level. In addition, the mandate of the YI would have to be changed, to one where consideration of costs would be the rule, rather than the exception. The basic idea today is that costs should not be taken into consideration. Consequently one has had to take account of costs in setting regulations. These are then some sort of "average" cost in companies affected by the regulation.

Other effects of allowing local variations can be briefly presented and will therefore be noted in the summary below.

Effects of Work Environment Regulations with Partial and Negotiated Compliance

We have now shown why and how we cannot expect regulations to be automatically implemented. As for the enforcement process itself, we have shown that given the institutional setting negotiated compliance may well be a cost-effective strategy for the YI. The question is then how this affects our conclusions from section 3.4.

The principal effect of the bargaining system as such in relation to full compliance is that WE improvements do not come about immediately. The delay with which we have been dealing consists of two parts. First, firms can adopt a policy of let's-wait-and-be-inspected. Secondly, even after inspection, compliance need not be immediate. This factor decreases the cost of WE improvements to the firm in question. First, because expenditure tomorrow is less costly than expenditure today. Secondly, WE improvements are cheaper if they coincide with other changes in capital equipment. In addition, account has to be taken of the effects of allowing local variations in the WE.

To begin with, it can be observed that the subsidy implied by public financing of the regulatory process cum control apparatus remains.

The other effects discussed in section 3.4 were contingent upon regulations leading to increases in WE quality. However, one of the outstanding conclusions from the preceding analysis is that at an aggregated level it is largely impossible to know with any precision the likely effects of the WE improvements induced by the Swedish WE regulations. All such effects identified in section 3.4 are modified by the nature of the enforcement system presented in section 3.1 and analyzed in this section.

We begin with resource allocation between firms and industries. In section 3.4, we argued that regulations would decrease the favourization of high-risk industries implied by under-compensation of employees or their under-estimation of risks. It was also noted that the similar effect of the Social Insurance system might be counteracted. Both these tendencies will be less marked when local variations in the WE are allowed, and when compliance is less than full.

The delays and variations will make it more difficult to "use" the regulatory process to force competitors out of the market. On the other hand, entry is made more difficult, since more stringent demands can be made on new establishments. (The latter will also give successful new entrants incentives to argue for stringent enforcement without local variations, to force old firms out of the market, thus counteracting the first effect noted in this paragraph.)

Turning to decisions within firms, it clearly becomes less likely that the tendency of the Social Insurance system to lower the provision of preventive measures will be counteracted. At the same time, the inefficiency entailed in uniform regulations is mitigated. The possibility of enforcing socially beneficial regulations that is neither wanted by employers nor by employees is also decreased.

We argued that allowing local variations in the WE will decrease the propensity to consider WE characteristics in long-term technological development. In principle, there should also be a minor such effect from the delay in compliance.

If the YI do not make full allowance for the long run effects of the enforcement strategy there is little reason to be surprised. Concentrating on short run effects will produce tangible results in decreasing the amount of social harm. In addition, the long run effects are typically external to the "game" between the YI and the company. Thus, neither employer nor employees will see any point in demands based on such motives.

As far as the effects on individual welfare of changes in the WE is concerned, we find ourselves confronted with considerable uncertainty.

In the present context, it is evident that the absence of WE improvements, or delays in effecting them, is to the advantage of firms and to the disadvantage of employees. Thus, the bargaining game and the institutional set-up reduce the possible gain for employees from WE regulations.

Local variations in WE quality and delays in realization decrease the risk that employees obtain more WE improvements than they would like. On the other hand, it decreases the workers' benefits from regulations in all other cases, and thus decreases the costs for employers.

Both delays and local variations decrease the risk for regulation-induced unemployment. Furthermore, both impose certain negotiation costs on the employer. However, the latter always has the option of immediate compliance, so these costs need not be borne unless the negotiation is considered worth while.

Finally, we may note a general problem with WE regulations. It is not humanly possible to cover all of the risks in the WE by means of regulations. Also, regulations as practiced today are essentially an ex post concept. Health and safety risks become apparent, and are then regulated, but not until they have existed for a while. If a decrease in risks is desired, it would be preferable to have a mechanism that screens our risks before they become manifest. One theoretical possibility is of course to have an "inverted" regulatory policy - one that states that no production process, new substance, etc., may be used until proven safe.⁹² This would undoubtedly have some strange effects, for example on technological development.⁹³ Apart from this, however, it would hardly be advisable within the WE area itself. One would probably "freeze" the existing production technology, and lose many WE improving albeit not "perfectly safe" innovations.⁹⁴ "... banning one risky product may decrease societal risk, or it may increase it. It depends entirely on what is left behind." (Huber, 1983, p. 29.)

3.6 Variable Product Prices

Although our main assumption is that product prices are fixed, a few observations on the opposite case may not be out of place here.

The discussion in this section can be kept brief. We need only ask ourselves how the conclusions in the preceding sections will be affected if the companies can raise the prices of their products (and still remain in business.) This presupposes that we are not dealing with a too close approximation of fully competitive markets with many producers. This situation may prevail for a number of reasons, one of which is public policy measures. (To be discussed in section 5.3.)

The principle difference in this case is that a price increase will shift some of the increase in production costs to consumers. A price increase implies a decrease in output, the size of which will depend on the price elasticity of demand. The reduction in output can be brought about in two ways.⁹⁵ Either some production units are closed down (at least one), or some (perhaps all) will decrease their output by a smaller amount. In the first case, there is certain to be some unemployment. In the latter there might not be, if firms anticipate an increased demand in the near future. Lay-offs are costly, and are generally avoided whenever possible in the Swedish labour market. The total result will depend on the exact nature of competition in the industry.

The merits of a price increase depends on the bargaining situation between employers and employees. The employer have to weigh the following considerations against each other: 1) a direct decrease in P (i.e., with prices unchanged, and subsequent adjustments in wages, etc.), 2) the cost of reducing wages and other benefits, and 3) the effect on P_{96} of a price increase. The last item can be either positive or negative.⁹⁶ It seems quite plausible that a price increase will often be included in the strategy chosen by the employer. In particular, this might be expected if the industry produces consumer goods, so that no direct long-term relationship exists between seller and buyer. It is even conceivable that regulations may sometimes prove a convenient excuse for a price increase (for example, in markets with price control).

For employees, a price increase is worse than a situation where the employer carries the whole burden of increased production costs. However, it is possibly better than any case involving eventual decreases in wages. (Not to speak of immediate ones.) All employees except anyone losing his/her job (as a result of the gradual decrease in output) are gainers in relation to the latter. I will not discuss whether the employees as a group could be said to gain from this. (Note that the total amount of wages and other benefits paid to the group may increase.)

If regulations have the effect of restricting competition, then they also increase the opportunity for price manipulations. If the latter decrease employer resistance to regulations, as seems likely,⁹⁷ then regulations can be said to facilitate new regulations. To the extent that this effect is unimportant, it is less likely that employees "receive" more WE improvements than they would have liked to "pay for", when product prices are variable (since they "pay" less).

If employers and employees both gain by price increases, this is because part of the burden for WE improvements is shifted to consumers. However, as noted in section 3.4, these are not well represented in the regulatory process. It is also well-known that large groups faced with individually small losses are unlikely to organize or to carry much weight politically.

3.7 Taxes and Subsidies as Work Environment Policy Measures

We now turn our attention to economic incentives in a more limited sense. In the previous sections we discussed WE regulations. These represent one way to induce higher levels of WE quality than would otherwise be provided in the employment contract. When regulations are considered as a policy tool, an obvious alternative is usually to use direct economic incentives - notably taxes and/or subsidies.

In this section, we will discuss the general applicability of taxes and subsidies to the field of WE. We will then review the (modest) Swedish experience with subsidies to WE investments in the next section.

In the present context, "tax" should be understood in very general terms. It is used to signify a cost imposed on the company through legislation. The cost is contingent upon what happens (or does not happen) at the workplace. The concept may thus include an "injury fee", liability claims, etc.

The inclusion of taxes represents a digression from our main theme, since taxes have not been used in this way in Sweden. However, this is an almost inescapable counterpart to a discussion of subsidies as a policy measure. The analysis would seem unduly restricted without a few words on the subject. Furthermore, the use of taxes in WE policy will be discussed as a policy alternative in Chapter 6.

We will confine our attention to the case of using taxes and subsidies to increase WE quality. (Though many of the results below are more generally applicable.) This aspect appears to be the politically relevant one. We thus implicitly assume that higher WE quality is desired by the policy-maker.

Taxes and subsidies may be used for this purpose in isolation or simultaneously with other WE policy measures. For example, one of the Swedish subsidies to be described below explicitly aimed at increasing the WE quality by more than the WE regulations demanded. However, the general results derived in this section and the next remain regardless of such considerations.

Consider now the use of taxes or subsidies to change the absolute magnitude of a single q , in relation to what it otherwise would have been.⁹⁸ I will argue that the opportunities in this respect frequently are those summarized in Table 3.3 below. Initially, we are only concerned with measures directly aimed at q (cf. below).

The differences between taxes and subsidies stem from the need for and the possibility of defining the status quo and subsequent changes in various cases.⁹⁹

Table 3.3: Possible use of taxes and subsidies to affect changes in the magnitude of q

	increase in		decrease in (existing)	
	tax	subsidy	tax	subsidy
increase q	difficult (I)	yes (II)	yes (III)	difficult (IV)
decrease q	perhaps (V)	difficult (VI)	difficult (VII)	yes (VIII)

Note: Case number in brackets.

Begin with an increase in q . It is (relatively) easy to encourage an increase in q by subsidizing company expenditures on q (II). On the other hand, it may be difficult to tax an inadequate increase in q (I).

In the former case, the status quo is simply the absence of any (new) investments in q . One can then subsidize all such investments. Obviously, this entails subsidizing also those that would have occurred anyway. This "price" has to be paid, because it is not possible to define the change due to the subsidy.

In the latter case, it is necessary to define the status quo in terms of q , and also the subsequent change in q . This makes strategical behaviour possible. It also places the burden of proof on the authorities, and forces them to acquire extensive information on individual companies.¹⁰⁰ Therefore, it is only feasible if q is easy to identify.

If q was previously taxed, then another possible way to increase q is to decrease the tax rate (III). (This of course implies that q is relatively easy to identify.¹⁰¹) If q was previously subsidized, one could theoretically increase q by decreasing the subsidy when q does not increase enough (IV). The problems here are equivalent to the case of introducing a tax on the insufficient increase in q .

Next we consider a decrease in q. One can then tax the existence of q, thereby decreasing it (V). The point of comparison is then the total absence from q. One must measure q, but the changes in it are uninteresting in themselves. In order to subsidize the fact that q decreases (VI) both the level and subsequent change must be ascertained.

It may be that expenditure on q was previously subsidized. In that case lowering these subsidies would decrease q (VIII). To lower an existing taxation of q to promote a decrease in q (VII) would again require the measurement of present level and change.

These distinctions holds for measures directly aimed at q. However, it is sometimes also meaningful to identify a non-q, so that increasing q may be thought of as decreasing non-q, and vice versa. In principle, this makes all policy measures usable. This is probably most easily understood in terms of an example. Occupational safety and health on the one hand, and injury risks on the other, present a good example of what I mean by q and non-q. Increasing the one means decreasing the other. However as we shall see, only in certain cases is any one of them identifiable in a form that can be the object of direct taxes (or subsidies). Namely, certain risks for occupational disease.

Before turning to discuss some more specific WE problems, we should also note that, ceteris paribus, taxes appear preferable to subsidies. We assume that both the tax and the subsidy lead to the same desired change in resource allocation, bear the same administrative cost, etc. If we use a subsidy, this increases government expenditure. Consequently, it becomes necessary to increase/introduce another tax to finance the subsidy. This is likely to increase the excess burden of taxation in the economy (cf. Atkinson and Stiglitz, 1980). In contrast, if we use the tax, it becomes possible to decrease other taxation, with the opposite result.

How do investments to increase WE quality fit into this framework? The WE quality can either be increased by increasing the quantities of positively valued WE characteristics, or by decreasing the quantities of negatively valued ones. In Table 3.3, it was seen that generally speaking, subsidies are best used to increase the volume of positively

valued characteristics, while taxes are preferable as a means of decreasing the amount of negatively valued ones.

For example, as will be discussed more extensively in Chapter 6, a tax could be used to reduce the number of occupational accidents. To achieve the same result as with a tax, one would need to pay a subsidy for each accident avoided. This is difficult. The general problem is that the subsidy must seek to reflect the relationship between accidents that have occurred in the company and some other factor. The question is which other factor? Ideally, the comparison should be with the accident record without the subsidy. While various subsidy schedules may be devised, I have not been able to find any that make the subsidy approach nearly as operational as the tax approach. A subsidy and a tax should have identical effects on the hiring policies of firms.

Furthermore, one could say that the present WII subsidizes occupational accidents. In that case, introducing differentiated premiums would lower the subsidy. As implied by the analysis in Chapter 2 this would decrease the number of occupational accidents.

Correspondingly, the quality of lunch rooms could be encouraged by means of subsidies, rather than by taxes on an inadequate increase in the level of provision. There is no direct lunch room quality tax that could be lowered.¹⁰²

It is easy, but not very rewarding, to extend this kind of analysis to other WE characteristics.

Another interesting possibility is to address taxes or subsidies to items closely correlated with WE characteristics. Notably, a number of WE characteristics are not obtainable in an easily defined form or unit. This is of course so with the general concepts "good WE" and "bad WE". But it is also usually the case with "safety", "pleasantness", and others. You cannot go out and buy a piece of safety any more than a piece of "good WE".

This is where subsidies to WE investments come in. The latter are supposedly closely correlated with the quality of the WE. Given a desired increase in these investments, the policy options available are those of tax exemption and subsidy. The Swedish experience offers examples of both options. The WE funds provided tax reductions while the WE loans were rather in the form of direct subsidies.

Finally, we note that occupational accidents should be viewed as being correlated with the WE characteristic "injury risk", rather than as WE features in themselves.

3.8 Economic Incentives in Swedish Work Environment Policy

Incentives in the form of taxes or subsidies have not been much used in Swedish WE policy. The only major example from modern times are two kinds of investment subsidies, and as will be seen even these were somewhat dubious in character.

The Swedish Experiment with Work Environment Subsidies

Two kinds of subsidy have been used in Sweden in order to raise the level of WE quality.¹⁰³ Both of these measures have been discontinued.

These were general WE subsidies. The term "general" denotes that the subsidy goes to any kind of WE investment. The other alternative is "specific" subsidies - those that can only be used for certain kinds of WE factors. The Swedish experience suggests that the intended general subsidy turns out to be a specific one. In fact, we will argue that this will usually happen when you try to use a general subsidy. In terms of their effects, only specific subsidies need therefore be considered.

In 1974 a law was passed,¹⁰⁴ according to which joint stock companies¹⁰⁵ were obliged to pay 20% of profits (if these exceeded 100,000 SEK) to the national bank as a WE fund (Arbetsmiljöfond).¹⁰⁶ The amount paid was deductible for purposes of corporate profits tax. (However the national bank paid no interest on the capital.) The fund

was to be used to finance WE investments that raised the quality of the WE beyond the demands of the WE regulations. This was exemplified by safety devices, sanitary improvements, dressing rooms, leisure facilities, etc., but not by changes in production technique. The employees of the company had to be in favour of the investment. If the fund had not been used within five years, the money was to be returned to the company and taxed.

The WE funds totalled 2.3 billion SEK. According to a government report, this implied a tax reduction of more than one billion.¹⁰⁷ This in turn would imply a subsidy in the magnitude of 110,000-120,000 SEK per granted application.¹⁰⁸

However, it is very difficult to make a correct assessment of the subsidy entailed in this system. The government report supposedly assumes that the money in question would otherwise have been taxable corporate profits (the tax rate in question being around 50%). This is far from certain. Companies have fairly extensive opportunities to "manipulate" their taxable profits.¹⁰⁹ The effective corporate profits tax rate is often low in Sweden. Consequently, it is very difficult to determine the size of the tax reduction in a case like this.

This also means that companies could determine to a certain extent how much they were going to pay to the WE fund. Payments to the fund were 20% of profits in 1974. However this was no ex post measure. Instead, the proposal for the law is dated in April 1974, and the law was passed on the last day of May. Companies therefore had ample opportunities to influence the amount of profits and consequently the amount paid to the WE fund. This makes it an even more precarious exercise to draw any conclusions regarding the effects of the WE funds.

At the same time, the WE fund represented a restriction on the possibilities open to a company. This introduces a possible disadvantage for the firms in question. Note, however, that to the extent that payments to the funds were voluntary, this increases the likelihood that the system entailed a subsidy. Nevertheless this is still not certain. For example, companies may require to show a certain amount of profits each year. (We should also point out that even if the WE funds were not a net subsidy to the company, they may still have subsidized WE improvements in relation to other

investments.)

Most applications came during the first two years (61% of the applications, 71% of the total amount applied for).¹¹⁰ The average amount per granted application and consequently (probably) also the possible subsidy was larger in the beginning.¹¹¹ The subsidy also automatically decreased with time as no interest was paid on the funds. By the end of 1982, 2.170 billion SEK of the funds had been used. Table 3.4 shows the distribution of WE fund financed investments between different uses.

Table 3.4: Distribution of investments financed from the work environment funds

Purpose	Per cent of expenditure
air	28.9
lunch room	14.0
building, repairing, painting	11.2
noise	8.0
sanitary construction	5.5
sporting facilities	5.0
sheds for employees	4.6
lighting	2.1
other	20.7

Source: Om statligt stöd till arbetsmiljöinvesteringar, p. 30.

From 1975 to 1978 a government guaranteed loan was available for WE investments which had no interest or amortization payments during the first two years (Arbetsmiljögarantilån, AG-lån).¹¹² This subsidy was financed by a payroll tax of 0.03%. The investment had to be used to improve existing buildings, machinery, etc. These loans were primarily intended for small and medium-sized firms (i.e. those without access to the WE funds). The employees of the firm had to be in favour of the loan cum investment. For any one firm the maximal size of the loan was 125,000 SEK.¹¹³ The loans were coordinated with the WE funds (large firms were the greatest beneficiaries of the latter). Loans were only granted for the difference between 125,000 SEK and the amount paid by the firm to a WE fund (no loans to companies that had paid 125,000 SEK or more to the fund).

The total amount allocated to these subsidized loans was 300 million SEK. The total government expenditure¹¹⁴ on interest on these loans was 28 million SEK.¹¹⁵ This implies government paid interests of less than 6,000 SEK per granted application (slightly more per firm with loans). As with the WE funds, the amount of subsidy entailed in this system is not easily determined. However it may be assumed that these loans were at least as good as other loans available to them since companies actually made use of them. It is difficult to be more specific than that.

Table 3.5 indicates the kind of WE improvements financed by the loans. Note that it is the distribution of measures directed towards different types of WE improvements which is shown in the table - not the distribution of expenditure.

Table 3.5: Distribution of different types of measures financed by subsidized loans

Purpose	Per cent of measures
air	38
localities for employees, and sanitation	30
noise	10
safety equipment	7
lighting	5
other	10

Source: "Rapport angående verksamheten med garantilån för arbetsmiljöförbättringar," Statens industriverk, 1979.

According to interviews with employers this subsidy had only a slight impact on investment activity. Some investments were made earlier, but few were undertaken that would not have taken place without the subsidy. This small impact is not surprising, given the probably small size of the subsidy ("Utvärdering av verksamheten med arbetsmiljögarantilån," Statens industriverk, 1978).

In their evaluation of the loans, The National Swedish Industrial Board (Statens industriverk) concluded that it was doubtful whether the effects justified the administrative costs¹¹⁶ (in total 7.4 million SEK¹¹⁷).

Analysis of Subsidies to Higher Levels of Work Environment Quality

If the WE funds gave a subsidy, it was in principle an entirely general one. However, as argued for example in the government report Om statligt stöd till arbetsmiljöinvesteringar (pp. 9-11) or in Ahonen (1983, pp. 19, 40), it is often difficult or impossible to distinguish a WE investment from investments in improved production technology. A change in technology generally entails new WE conditions. It will almost never be possible to separate the "WE part" of the investment from the rest. This is noteworthy, not least because the decision on production technique is the most important determinant of the WE. This gives the limits within which subsequent measures can produce only minor alterations (Om statligt stöd till arbetsmiljöinvesteringar, pp. 9-10).

Consequently, one is faced with two options. One possibility is to agree to subsidize an "investment package" where the WE investment is only one (possibly minor) part. This implies that one will often subsidize other elements that are inseparable from WE investments (new production technique, etc.).¹¹⁸ Of course, in relation to the size of the subsidy, the WE effects may then be quite modest.

Alternatively, one may wish to restrict the subsidy to "pure" WE investments. As shown above, it is then impossible to subsidize an important class of WE investments.¹¹⁹ Nevertheless, I would suggest that the latter view will generally be taken by the administrative agency. That is the only way in which they can have any "measurable" impact on the WE. Lindsay (1976) argues that bureaucrats will tend to concentrate resources on those parts of output that can be monitored by their superiors. Furthermore, with the former option, subsidies to WE investments would in practice become indistinguishable from general investment subsidies. (Barring only those investments that lead to a decrease in WE quality.) This would probably be felt to be unsatisfactory.

Therefore, any general WE subsidy will become specific, in the sense that the WE decisions entailed in change of production technology will fail to qualify for the subsidy. This view of "general" WE subsidies seems to receive some confirmation from the actual use of the WE funds shown in Table 3.4. To restrict the subsidized loans to existing establishments was thus perhaps not as serious a limitation as it might appear at first sight.

Viewed in this perspective, the WE funds and the subsidized loans were the same kind of subsidy: specific in the sense that "identifiable" WE investments were subsidized; general in the sense that all kinds of investments that qualified in the previous sense could be subsidized. However, they were financed differently.

We begin our further analysis with the WE funds. Remember that the money in the WE funds still belonged to the individual company. In companies where profits were fully manipulable and the company had no special reason to show profits, it is unlikely that the WE funds would have changed investment decisions. The tax reduction given for a WE investment could hardly outweigh taxes paid on the 80% of the profits not paid to the fund. Thus, the fact that substantial payments were made to the funds implies that profits were not that controllable in all companies.

The other possibility is that the company showed profits, and consequently had to pay to the fund. This could occur either if profits were not fully manipulable, or if there were other reasons for showing profits. The fund then placed a restriction on the use of resources within the company which may or may not have been binding.

Under what circumstances will this system have affected WE investments within a company, and how? The first requirement is obviously that the funds are relevant at the margin. In other words, that the amount paid to the fund exceeded the amount of planned WE investments - investments that would have taken place anyway. (This excludes the unlikely case where the money paid to the fund was left there, taken out and taxed five years later, cf. below.) "Planned" here refers to the kind of WE investments that were eligible for finance from the fund. Note that the 2.300 billion SEK paid to the funds gives the upper limit for the amount of WE investments due to the funds. The

fund would first be used to finance WE investments that would have been undertaken even in the absence of the funds. (A similar argument is valid for the loans. Cf. the alleged small impact of the loans on investment activity mentioned above.)

Let us now hypothesize that the WE funds were a voluntary system, in order to examine if the system could have been favourable in net terms for the firm. Paying part of profits to the fund is then one alternative way of financing WE investments.

It turns out that the system is favourable in some but not all cases. To see this, note that the system with the WE funds meant that total investment cost may be written off instantaneously - free depreciation. This implies that the effective tax equals zero for marginal investments (since it is financed from equity capital). Given the complexity of the Swedish tax system, this is not necessarily the best option. It can easily be shown that the cash flow may be better each year when a loan is used to finance the investment instead of the WE fund, dependent on the rate of interest, depreciation and amortization. Such an anomaly is also revealed by the result that the effective marginal tax rate for the marginal investment may be negative in the Swedish system (Södersten and Ysander, 1985); this is especially likely for investments in machines, possibly also for buildings. These considerations opens the possibility that use of voluntary WE funds would not be the best option in spite of the fact that they involve a zero effective tax on investment.

Let us now first examine the case where financing of WE investments via the fund would have been profitable if the funds had been a voluntary system. This means that some WE investments have become more attractive. It would change the relative profitability of different investments within the individual company. The amount of such investments - those increasing WE quality - would thus have increased. (In reality investment decisions may not be adjustable at the margin. It is therefore also possible that there was no effect on these investments from the funds.) If this was simply a re-allocation of existing resources, other kinds of investment would decrease.¹²⁰ This decrease could fall either on non-subsidized WE investments (primarily non-identifiable ones, but see below on employee "voting"), or on "other" investments. The effect on the total amount of WE investment in these companies would thus be uncertain.

With the present assumptions, the funds may also have entailed a net subsidy to the companies concerned. It should be obvious, however, that any estimation as to its size would be conjectural. This subsidy was financed through general taxation.

We must then consider how the total amount of investments was affected by the hypothetical subsidy. Those companies that qualified for a WE fund were in fact given a subsidy by the rest of society.¹²¹ Thus, the company was put in a better economic situation. This could produce a tendency for all kinds of investments to increase, ceteris paribus, which would counteract the decrease in non-subsidized WE and "other" investments. Obviously, the effect would not be identical for different companies.

Another question is whether the employer or the employees received the subsidy (assuming that there was a net subsidy). The main reason to suspect that the WE funds increased the expenditure to the benefit of employees is the latter's influence on the use of the funds. WE investments may have been undertaken that gave employees a small gain that was not fully countered by a fall in other benefits (cf. the discussion in section 3.3). We should note also that the reason given for creating the WE funds was to transfer a part of the companies' profits to their employees (profits being considered relatively high in 1973/74).¹²² Finally, it is worth remembering that employees may have gained (or lost) from the change in the composition of the employment contract implied by the change in investments, in the way discussed earlier in this chapter.

However, from the fact that companies would voluntarily have chosen the WE funds to finance some WE investments, it does not follow that introduction of these funds was to the advantage of companies. With payments to the fund exceeding the amount of planned WE investments, a binding restriction was put on the use of company resources. By preventing other uses, this may have entailed a net loss to the company. This would still have increased the attractiveness of WE investments at the margin, with ensuing effects corresponding to the ones discussed above. (Those associated with the net subsidy would of course be reversed. In particular, it becomes less likely that employees would gain from the funds.)

For the second case, we now return to the possibility that the WE funds did not decrease the required rate of return on any WE investments. (In other words, would not have been voluntarily chosen to finance any WE investments.) To the extent that payments to the fund exceeded the amount of planned WE investments, this implies a net loss to the company. Previously "unprofitable" investments will now be undertaken, since the alternative is even worse - to leave the money tied in the fund for five years and then have it taxed. Only in exceptional cases would it have been advantageous to leave the money in the fund. Under normal circumstances they would be used for WE investments. Thus, certain kinds of WE investments may increase. The total outcome will depend on the effects of the net loss element, as described for the previous case above. The same holds for total WE investments in the company.

The discussion so far has treated specific WE investments as a homogeneous group. In reality, the extent to which financing these investments from WE funds made them more profitable will have varied within the group. Hence, there were shifts within this group, with effects similar to those discussed above. (A crucial issue is whether the investments that were made more profitable exceeded the amount paid to the fund.)

As indicated in this discussion, the WE funds will have affected different companies differently. Thus, the effect on total WE investments in society as a whole as well as within individual firms is uncertain.¹²³

In contrast to the WE funds, the subsidized loans were financed by means of a uniform payroll tax. Instead of a subsidy from tax payers to a part of the business sector, we have a re-allocation between economic activities. We assume that the loans as such (financing apart) entailed a net subsidy. As noted above, this is more probable for the loans than for the funds, since the use of the former was voluntary.

If the payroll tax is paid by the employer¹²⁴ (not shifted to employees), and if each company received a subsidy which corresponded to what they had paid in, the effect would be largely analogous to that of the WE funds. The total resources of the firm would not change, however, so the effects associated with the net subsidy would not be present here.

In practice, the subsidy received held no relation to the tax paid in. The subsidized loans were primarily intended for small and medium-sized firms. Consequently, employers and/or employees in these and/or firms with many "identifiable" WE problems would gain at the expense of other employers. The extent to which employers and employees respectively in subsidized firms gain (or lose) depend on how the subsidized WE investments affect other payments from employer to employees. The total amount of WE investments in a particular firm would of course depend on it being a "gainer" or a "loser".

Now we assume instead that the payroll tax is totally shifted to employees. This means that employees pay for this kind of WE investments. Disregarding the allocation between firms, this might be to the advantage of employees if, for example, identifiable and positively valued WE characteristics were previously underprovided in the employment contract. This would depend on how other benefits were decreased to "pay for" the payroll tax. If on the other hand the employment contract was suitable in this respect, it would be to their disadvantage. The effect on total WE investments within the firm would again be uncertain.

Let us now re-introduce the allocation between firms, but retain the assumption that the payroll tax is totally shifted to employees within each company. In this case, employers and/or employees in subsidized firms would gain at the expense of other employees.

It does not seem worth while to extend this discussion to include intermediate cases of shifting of the payroll tax. Nor will the discussion be extended to include the possibility that the tax is partly shifted to consumers through price increases.

In addition to the above effects, there are some features that were shared by the WE funds and the loans. First, in both cases, the investment had to be approved of by (a majority of) the employees' safety representatives.¹²⁵ It seems likely that these would be more interested in investments that favour present rather than future employees. However this possible disregard for the long-term perspective largely coincides with the general impossibility of subsidizing such investments (see above). It would therefore hardly be noticeable in the distribution of investments. Of greater interest is that it may be easier to agree on WE improvements of a collective nature. One often expects a tendency to undersupply collective goods. Here, however, the decision is whether or not to approve a specific WE investment. The greater the number of people who benefit from the investment, the easier it is to obtain a majority. This principle may well carry over to the employees' representatives (especially if the latter have equity goals). This suggestion is supported by the data reported in Tables 3.4-3.5. The influence exerted by employees also means that their expression of preferences regarding the WE to employers becomes institutionalized. However, to the extent that such a transfer of information is desirable, it ought to take place anyway.

Secondly, both the WE funds and the subsidized loans have been in the nature of "one-off" events. If any such measure was to be made a regularly recurrent feature of WE policy, account would have to be taken of the effects on expectations and long-term planning in the companies.¹²⁶

We have studied the effects of two kinds of rather general WE subsidy. We argued that such subsidies usually become specific in the sense that only certain investments related to the WE would be subsidized. It was shown that the effect on the total amount of WE investments was unclear. This applied to both individual companies (including those receiving net subsidies), and to the economy as a whole. On the other hand, certain types of WE investment have undoubtedly increased.

It might be argued that there are other kinds of WE investment that ought to have received encouragement rather than those favoured by the "general" subsidies above. In particular, a subsidy aimed at reducing occupational injuries might gain many advocates. On the other hand, it might prove slightly difficult for example, to find a rationale for government subsidies to sporting facilities and lunch rooms. However, as was argued above, an "injury tax" would be a superior alternative for this purpose.

Subsidies could also be used in another way to reduce occupational injuries. This would be to subsidize risk decreasing investments as a group. However in this case, there would again be no effects on long-term and technological development.

Concluding Remarks on the Use of Taxes and Subsidies in Work Environment Policy

In the last two sections we have studied the possibility of using taxes and subsidies to induce higher levels of WE quality.

It was found that general subsidies, such as the Swedish ones, will lead to increases in certain types of WE investment. However the effect on the total amount of WE investments is uncertain.

It was observed in Chapter 2 that one effect of the Social Insurance system was to reduce the incentives for injury prevention. It was argued that this could be one reason for using WE regulations to induce higher levels of WE quality. Another reason might be that employees underestimate the risks they face, thus introducing an anti-prevention bias to the labour market negotiations.

In the Swedish WE regulations, the inefficiency entailed in uniform regulations is partly avoided. However, there is, and probably always will be, a high degree of uncertainty concerning the effects of these regulations on the WE. As policy instruments, they are clearly a considerably less than perfect means of bringing about changes in the WE.

Both of the above issues can be viewed as negative externalities caused by occupational hazards. The use of Pigovian taxes to reduce the level of activities that cause negative externalities has long been and still is part of the economist's stock in trade. Their usefulness in this respect has often been stressed (see e.g. Baumol, 1972).¹²⁷

The use of taxes in WE policy will be further discussed in Chapter 6. As we shall see, taxes may provide a more effective way of achieving a certain standard in the case of occupational accidents. However taxes do not generally present a viable alternative in the case of occupational diseases. Subsidies may be used to promote some of these effects (provided that the side effects are considered beneficial or can be ignored). It would not be very effective, however, since there are no effects on technological development.

The overall conclusion from this chapter would seem to be that it is rather difficult to use public policy to directly influence the physical shaping of the WE. This highlights the importance of labour market negotiations. (This is also recognized by Swedish WE policy, in which a guiding principle is that workers' protection must take place at the workplace.¹²⁸)

If the parties tend to make "wrong" decisions, either because of improper incentives or because of lack of information, it is difficult to correct these "errors" by means of public policy. Information plays a central role here. Decisions based on deficient or incorrect information are likely to be inferior. In Chapters 2 and 3 we have been concerned with the incentive structure. It is now high time that we discuss the measures that need to be undertaken in order to provide our society with information on the WE. This will be the subject of Chapter 4:

Information policy is not invariant with regards to other kinds of WE policy. In the present context, we should note that an injury tax is an important informational tool. Research may tell us about the danger of machines, chemicals, etc. An experience rating gives a unique piece of information - the precariousness of the WE of the individual firm (Viscusi, 1980a, 1983b, p. 90). This is a powerful instrument for well-informed choices of employment (while the present Social

Insurance system has the opposite effect).

Notes to Chapter 3

1. See Gullberg, Rundqvist and Starland (1983), pp. 211-225, for an overview.

2. See, for example, Gullberg, Rundqvist and Starland (1983), pp. 17-19, and Jönsson and Lyttkens (1981), pp. 16-18, for a short overview of earlier legislation in the area. The latter also gives some notes on the history of the WII.

3. References on the problems associated with the analysis of particular regulations are given in Chapter 1, p. 12.

4. This is not equivalent to assuming that the WE regulations have a non-negligible impact on the safety and health of workers, as will be clear from the discussions below.

5. We include only a brief description of the AML. For a full presentation, see Gullberg, Rundqvist and Starland (1983).

6. AML 2nd ch. 1st section.

7. AML 3rd ch. 1st section.

8. For example, there are safety committees that exist at large companies (AML 6th ch. 8th section). However, according to the agreement reached between the union and employers' associations, decisions within the committee that have economic consequences must be unanimous in order to be binding for the company (Arbetsmiljöavtalet, p. 34). Thus, we can leave their activities out of the analysis in this chapter.

9. For other functions of the ASS, see Chapter 4.

10. In addition, there are two members who represent the employees at the ASS. However, their presence is of no consequence for the analysis in this chapter. They do not have a right to vote on regulations, orders, prohibitions, etc.

11. The capture theory of regulation (see Veljanovski (1982b), pp. 93-94 for some references) forwards the hypothesis that "... regulation is secured by politically effective interest groups which invariably means that it protects producers or sections of the regulated industry. As Stigler [Stigler (1971)] states 'as a rule, regulation is acquired by industry and is designed and operated primarily for its benefit' by redistributing income in favour of the regulated industry in return for electoral rewards to the politicians who engineer the redistribution." (Op. cit., p. 93.) In the present case there are in principle ample opportunities for such behaviour, since the interest groups are officially appointed to govern the regulatory process.

12. This can be directed towards a company as such, whereas fines and imprisonment due to non-compliance with an order or a prohibition (or due to regulations that allow immediate punishment) presuppose that an individual has been punished.

13. AML 9th ch. 1st-2nd sections.

14. AML 9th ch. 5th section.

15. In Samlad tillsyn av ARBETSMILJÖN, new priorities for the activities of the YI are suggested. More specifically, it is argued that the first priority should be the way companies deal with and organize their work concerning WE issues. The control of systems gains increased importance in relation to details of WE quality. However, the latter should not be abandoned.

I have not endeavoured to analyze these suggestions. Nor is it immediately obvious how (and if) implementation of these ideas would affect the results below.

16. The cost for the work of safety stewards are presumably shifted to employees. To the extent that this is not the case, employees gain at employers' expense.

Some of these responsibilities follow from legislation, for example, the right for the stewards to perform their duties during working hours without loss of pay (Gullberg, Rundqvist and Starland, pp. 150-152). These responsibilities are supported and extended through agreements between the unions and the employers' associations (Arbetsmiljöavtalet, pp. 17-24; Gullberg, Rundqvist and Starland, 1983, pp. 149-150).

17. The Penal Code, 3rd ch. 7th-9th sections. However, there are not many cases of this kind. In 1981-1983 c. 85 persons were brought to court. Of these, slightly more than half were found guilty (Arbetsarskydd, nos. 1982:12, 1983:10, 1984:6). However, not all cases come to the knowledge of the ASS. According to Göran Lindh, ASS, courts report only 70-75% of WE related cases.

18. Gullberg, Rundqvist and Starland (1983), p. 192.

19. Attributing 1/3 of the ASS to these activities. (Cf. Lundberg (1982), p. 57.)

This abstracts from the fact that approximately 10% of the resources of the YI are used for education and information (Samlad tillsyn av ARBETSMILJÖN, p. 78). On the other hand, the work of municipal inspectors is not included. In 1983, the cost for this was around 15 million SEK (op. cit., p. 36).

20. The YI also has other functions. In particular it spreads information. Cf. Chapter 4.

21. A well-known exception being the Occupational Safety and Health Administration (OSHA) of the USA, especially during the 1970s. Cf. e.g. Kelman (1981b).

22. Note that the trend has been to increase the proportion of written notices. Thus, the percentages in the 5th row of Table 3.1 should not be interpreted as a decrease in the use of legal sanctions.

23. Lundberg (1982), p. 130. See also Nordfors (1985), pp. 72, and 151.

24. Arbetsmiljövtalet, p. 15.

25. Ibid., p. 41.

26. Ibid., p. 6.

Rulings can be made under the penalty of a fine (ibid., p. 4), just as orders and prohibitions from the YI may be.

27. Nordfors (1985, pp. 137-138, 160) argues that the intention behind this "equal representation" was to ensure a suitable weighing of WE quality against the costs of achieving it.

28. As mentioned above, the final ruling lies with the government. This requires that the employer or the employee representative files a complaint against the decision of the ASS.

29. According to Gunnarsson (1984), stipulations in the AML concerning "cooperation" between employer and employees at the workplace largely resemble a codification of already existing practices. See also Moberg et al. (1982), pp. 67, 102, and 112.

Nordfors (1985, p. 104) points out that the 1976 agreement between employers' and employees' associations gave the safety committees at companies a stronger position than the law. This had been a demand of the trade unions, which parliament had not met.

30. It is 16.5% of the charge for workers' protection that goes to the ASS and the YI. The rest goes to the ASF. The tax rate is 0.155%.

31. An additional question is whether there is any a priori reason to believe that a public agency, such as the present labour inspectorate, is more effective as a controller than a private organization would be. If so, public control would be to the advantage of the employees. I can think of one argument that points in that direction, namely where employers adopt a policy of procrastination. As we shall see below, such opportunities are not unimportant within the present system, and it seems probable that it would be enhanced by the alternative. For instance, a refusal to permit entry for the privately organized inspectors could lead to strategically important delays, and such entry would in extreme cases require court proceedings to be forced on the employer. On the other hand, a publicly employed inspector on official assignment could call for the police to force an entry (AML 7th ch. 5th section). It does not seem certain that this difference in administrative efficiency could be fully countered by stipulations in the labour market contracts. (One can of course also think of intermediate cases, such as making it illegal to refuse entry to an inspector officially appointed by a trade union.) However, it is also possible that the punitive measures available to a union are more "effective" than those of the YI.

32. According to Kelman (1981b, pp. 148sqg.) the whole institutional set-up favours agreement around pro-protection values. In particular, employers' representatives are more in favour of high-quality WE than individual firms (ibid., pp. 117, 148-158, 233). This strengthens the case for the ASS and the YI representing an effort to increase WE quality.

33. A quite different question is whether there will be efforts to raise the quality of the WE against the wishes of both labour market parties. This will be discussed below.

34. Cf. Moberg et al. (1982) and Nordfors (1985) for a historical overview of the role of the unions in the development of present day regulations.

35. It is also possible that union representatives are of the opinion that regulated increases in WE quality do not affect wages or other benefits. If this is the real situation such increases are net gains for employees.

36. As noted above, Ahonen (1983) explains the origins of labour protectional legislation in terms of an externality from working-time to leisure. In my opinion, this externality does not necessarily remain today, society and the labour market having had time to adapt to the new circumstances.

37. Viscusi (1979a, ch. 4) has shown that workers may well prefer jobs associated with imprecise probabilistic outcomes to positions whose implications are known with precision. This effect decreases with the transaction cost of switching jobs.

38. We assume here that the risk perception is corrected by the regulation. If this is not the case, the welfare effect for the employees is more problematical, as will be shown below.

39. This observation is a major inspiration for the emerging implicit contract theory. Cf. n. 41, Chapter 1, n. 1, and Chapter 2, n. 9.

40. Given our assumptions above, this is true even if the WE is gradually improved during the work on formulating the regulation. This is quite possible, since both employers and employees take an active part in the work on new regulations, apart from being represented on the board of the ASS (see Lundberg (1982), pp. 76-78, for a short description of the process). However, to the extent that such gradual improvements occur, the effects on P and on workers' utility should be less dramatic (though not necessarily smaller).

41. This parallels the fact that employees appear to prefer pecuniary remuneration that does not vary with short run fluctuations in profits. This may of course be explained by risk aversion. Cf. Chapter 2, n. 9.

42. One can of course construct cases where this is also beneficial for these employees. For example, possibly all workers re-employed by the new owner, who has incurred less capital costs than the former owner.

43. This is substantiated by regulatory experience. See Om statligt stöd till arbetsmiljöinvesteringar, pp. 95-96, and 135.

44. It should also be noted that labour market negotiations would in principle provide a possibility for speedier realization of WE improvements than regulations. This may often be an advantage for employees, such as in case of new discoveries of health risks.

45. This will also change the relative strength of the parties to WE negotiations at the local level. Employees will gain from the opportunity to apply to a higher decision level (the YI) which is beneficially disposed towards demands for a better WE.

We may also remind the reader of the opportunity for a safety steward to stop work, that follows from the AML. This may constitute a powerful instrument in negotiations. In fact, in the private sector it may be too powerful from the point of view of the employee. Stopping work may cause extensive production losses, which may also adversely affect employees. Paradoxically, it may therefore be more effective in the public sector.

46. This supposes that "remaining" negotiations are not made more costly by the regulations. At a guess, I would in fact suggest that they become less so, given the limitations imposed by the regulations.

47. See Jönsson and Lyttkens (1981), ch. 9, for examples of this possibility from the WE area. In practice, this tendency will be tempered by the way WE regulations are enforced, cf. section 3.5. In section 5.2 we will discuss government policies that have an opposite effect. I.e. by slowing down structural transformation they potentially delay WE improvements.

48. Bartel and Thomas (1985) suggest that such considerations are a major explanation for the workings of the OSHA, as does Maloney and McCormick (1982).

49. Specific branches may also be poorly represented (Nordfors, 1985, p. 138).

In addition, those representing trade unions and employers in the regulatory process are only to a limited extent representative of the opinions of their members. See Kelman (1981b), pp. 117, 150-158, and 233, and also n. 32 above.

50. Cf. the analysis of G. Hansson (1983, section 3.6). See also the first-order conditions in the problems discussed in Appendix 1.

51. This assumes that employees with greater assets will be less willing to incur job risks. Supporting evidence is found in Viscusi (1979a), ch. 14.

52. The firm as a vehicle of control is, of course, a well-known feature in economic theory. For a recent interesting contribution and critique in this tradition, see Holmström (1982).

53. If the valuation of the WE changes greatly, full compensation may not be possible within the limits given by avoidance of bankruptcy.

54. In Moberg et al. (1982), it is argued that the increased interest for psycho-social WE aspects in legislation is due (at least partly) to the fact that the number of white collar workers has increased relatively, and that their "WE problems" typically are psycho-social in nature. This is probably correct as far as it goes. However, I would like to add that the change in taxation will have had a considerable impact on their situation, since they frequently have higher pay. In addition, their increased number has meant that negotiations with the employer have become more collectivized (cf. Chapter 5, p. 204 and n. 32). Information regarding psycho-social

aspects as contributory factors to ill health has also increased. Thus, there is good reason to believe that white collar workers may also gain from WE regulations. The increase in their number has enabled them to campaign for such measures.

55. In the words of Lundberg (1982), p. 110, the problem with regulations is that frequently there are none. Cf. also the discussion on p. 114.

56. Cf. Musgrave (1959), pp. 13-14.

Kelman (1981a) argues that this is the case. According to Ashford et al. (1980, pp. 12-13) it could be argued that a good WE is a merit good, it being a benefit concerning which "... there is a widely shared social consensus that [...] no member of society should be without [it]" (ibid.).

Altruism has also been suggested as a basis for government actions (e.g. Viscusi, 1983b, p. 80), but, as noted in section 1.2, such considerations are left out of this study.

57. Cf. Chapter 5, n. 6.

58. This is an example of what van Gunsteren (1976) calls the rational-central-rule approach to public affairs. He argues that this is the approach normally chosen by governments, and that it usually fails. The analysis in this study supports that hypothesis (at least partially).

We may also observe along with DeMuth (1980a,b) that regulations are a "cheap" way of achieving a policy goal. Politicians may promote health and safety, and the costs would fall on individual companies (or employees) rather than on government revenue.

59. In the context of WE regulations, this observation is made by, for example, Mendeloff (1979), Skogh (1982), Smith (1976, p. 61; 1979b, p. 149), Viscusi (1983b, p. 114), and Viscusi and Zeckhauser (1979, p. 438).

60. See Lundberg (1982), pp. 103-107, for a more extensive discussion of these problems.

61. This result was derived by Becker (1968), pp. 183-185, 191-193, in his seminal article on "the economics of crime."

62. The risk introduced by fines and detection rates implies that maximum fines can never be optimal since the financial loss suffered by the company is ultimately borne by risk-averse individuals (see Polinsky and Shavell, 1979).

63. Cf. Chapter 2, pp. 65-66.

64. Only Bartel and Thomas (1985), Cooke and Gautschi (1981), Smith (1979b) and Mendeloff (1979) found any impact. This was post-inspection (Bartel and Thomas), post-inspection of large plants (Cooke and Gautschi), post-inspection of small hazardous industries (Smith), and for some special types of injuries (Mendeloff). However see the critique of Mendeloff's result in Viscusi (1983b), p. 34 and pp. 178-79 n. 42. Note that the critique of Smith's method in Viscusi (1983b), p. 35, is not quite to the point, since Smith compared the injury rate

in two groups of firms, both of which had been singled out for inspection.

In a study of pre-OSHA safety standards Chelius (1974) found a small impact on injury rates.

65. Viscusi (1979b) calculated that in 1972-75 an enterprise stood on average a less than 1/50 risk of being inspected, and faced an average penalty per inspection of \$ 95. (The average penalty per enterprise being \$ 1.52.) Similar calculations are found in Smith (1976, pp. 62-64; 1979b), and in Nichols and Zeckhauser (1977). Between 1972 and 1980 there was a tenfold increase in penalty per violation, but they still remain modest (Viscusi, 1983b, p. 19). See also Mendeloff (1979), pp. 87-93, for a critical discussion of this kind of analysis.

66. See Nichols and Zeckhauser (1977), pp. 47-51, and Viscusi (1983b), pp. 10-25, for a discussion of this.

67. For example, injuries not being due to controllable factors or non-compliance, and inspectors not being able to detect violations. This is usually discussed in studies of the OSHA. See, for example, Bartel and Thomas (1985), Chelius (1977), pp. 8-9, Mendeloff (1979), pp. 85-87, Nichols and Zeckhauser (1977), pp. 49-51, and Smith (1976), pp. 64-67.

68. This is not to say that there might not be similar problems in Sweden. However, even if this is the case, they could often easily be rectified within the existing system. I want to focus instead on the problems associated with the structural properties of a system of WE regulations.

69. The same kind of terminology is used by Lundberg (1982) in his description of the enforcement system.

70. The case for WE improvements is then strengthened by the fact that the YI is consulted before such major installations/changes. However, this effect is weakened to the extent that firms can expect to get away with only "partial compliance", cf. below.

71. Lundberg (1982), p. 155, talks about the (unused) possibility of general deterrence in the Swedish system. Note that this can refer only to the rule-setting of the ASS. Within the present system, the YI can only deal with "second stage" deterrence. Namely, make individual firms follow their decisions.

72. They may vary a great deal even within narrowly defined industries. See Viscusi and Zeckhauser (1979), p. 443. See also Leone (1976).

73. See Flodgren, Hydén and Sandström (1981), p. 248, Gullberg, Rundqvist and Starland (1983), pp. 71-72, Lundberg (1982), pp. 48-49, and Nordfors (1985), pp. 129-130.

74. We suppress other "bureaucratic" goals, not because they would be non-existent but because they are less interesting for the problem at hand. We should mention, however, that Lundberg (1982) notes the possibility that inspectors tend to be lenient in order not to jeopardize a future career within the company health service (företagshälsovården).

75. The relation between parliament and the agencies is discussed in Edlund (1984) and Kelman (1981b).

For a general discussion of the problem of controlling the behaviour of the lower level in a regulatory hierarchy, see Diver (1980). The control of the YI by the ASS is discussed in Kelman (1981b), chapter 5, Lundberg (1982), pp. 145-146, and 199-202, and Samlad tillsyn av ARBETSMILJÖN, chapters 5-6.

The principal-agent problem is analyzed in Shavell (1979c).

76. I present the penal strategy in its "harshest" form. The YI always has the possibility of practicing it in a more lenient way. Note also that the YI does not have full control over the severity of the punishment (see below, pp. 120-121).

77. Nos. 1), 3), 4), and 5) are discussed by Lundberg (1982) as defensive strategies available to the employer.

An additional problem with widespread use of a penal strategy is that it might decrease voluntary compliance (Kelman, 1981b, p. 209).

78. The possibility of ordering immediate compliance (cf. p. 91) is seldom used. (Information based on interview with Göran Lindh, ASS, and on the frequency of such cases among those against which an appeal has been filed.) When it is used, an appeal can be filed against this procedure, in which case it may be annulled by the ASS.

79. Though one might debate if this is indeed a problem. For example, if fewer people are exposed to the hazard at the new workplace, social harm might well have diminished. However, Lundberg (1982) found that the inspectors at least saw it as a problem.

80. Kelman (1981b, p. 186) also found that inspectors dislike paperwork, which is undoubtedly increased by the penal strategy.

81. In Fenn and Veljanovski (1984), this strategy consists of offering the company the choice of either penalty or compliance in return for no prosecution. The inspectorate would then save the costs of prosecution in the latter case, whereas there are no negotiation costs in the former. As no such penal strategy exists in Sweden, as was noted above, the payoffs of the two strategies will be different in our case.

82. In reality, achieving t_1 or t_2 is not costless for the company. Both activities will require resources with a positive opportunity cost. Therefore, one class of inspections of intended bad WE will immediately lead to WE improvements. The existence of these hardly change the nature of our conclusions.

83. Lundberg (1982), p. 130.

84. Calculated from Verksamhetsrapport Yrkesinspektionen 1983-02-15 and Verksamhetsrapport Yrkesinspektionen 1984-02-16.

85. This, and the information below on fines, imprisonments, etc., is from Arbetsarskydd, nos. 1982:12, 1983:10, and 1984:6.

86. The latter is confirmed by the 1981-1983 material.

87. That r_3 is only an assessed probability means that the YI is uncertain whether the penalty is large enough to ensure compliance ($v > c$?). Cf. pp. 120-121.

88. There is often disutility associated with law-breaking as such (i.e., the punishment apart), especially when it puts other persons' life and health at risk. For the individual there are moral and social aspects, and for firms there is a loss of goodwill etc. This disutility varies among agents. An intended state of unsatisfactory WE conditions could be interpreted as a sign that it is relatively unimportant for the firm in question. (In addition, the disutility of breaking the law may well decrease with the number of offences).

89. The reason given by the YI for choosing the penal strategy (when it is done) is usually that the "negotiations" has failed (Lundberg, 1982, p. 129).

90. Inspection of the former is to be given priority in relation to the latter, according to the YI (Arbetsarskyddsstyrelsen och yrkesinspektionen 1982: Verksamhetsberättelse, p. 29).

91. Note that cost-benefit analysis of regulations, coupled with strict (penal) enforcement by the YI, is not necessarily a second best solution, given the inefficiencies in uniform regulation.

92. "Proven safe" would have to be given an operational definition deviating from the literal interpretation, since it is not possible to prove that something is not harmful with traditional statistical methods. (This is the case with certain "safe" products, such as pharmaceuticals.)

93. See Huber (1983) for a general critique of this kind of regulation.

94. Note that the reality of technological and commercial change does not permit the use of a strategy that allows new technologies, etc., as long as they are safer than the ones they replace.

95. We exclude the case where the industry was working over its normal capacity before the regulation. Otherwise reductions in output could be accomplished simply through a decrease in over-time work.

96. In the simple case of a pure monopoly and a regulation that does not change the marginal cost structure it will be unambiguously negative.

97. See section 5.3 for evidence of this.

98. We do not consider relative changes in magnitude. If that is the purpose, it may also be accomplished by manipulating the other items under consideration. A relative increase in q could for example come about through a decrease in other items. Thus, the additional policy options in the case of relative changes follows directly from the analysis below of changes in one variable.

99. This analysis is akin in spirit to Wittman (1984). He shows inter alia that in the choice between the carrot and the stick, you should avoid compensating/punishing people (or firms) for their normal behaviour. This saves administrative costs.

100. If one tried to subsidize increases in q itself, rather than investments to increase q , similar problems would ensue. Since any increase in q would be due to company expenditures, the option above is always open.

101. Thus, if III exists, this implies that it is exceedingly possible that both I and IV can be used, though presumably only I is a real alternative. It is still likely that III would be the superior alternative.

102. There may of course be situations where both taxes and subsidies are applicable. For example, if the aim was to encourage the building of lunch rooms, use could be made of both a subsidy to this activity and a tax on the non-existence of such facilities. This is due to the fact that lunch rooms are easily identifiable.

103. The description below of the rules for these two subsidies follows the Government report Om statligt stöd till arbetsmiljöinvesteringar, pp. 22-24.

In addition, general investment subsidies and other subsidies exist, which can also be used for WE purposes. The government report argued that these provided all of the necessary subsidies to WE improvements (pp. 2-3; an overview of some of these subsidies is found in app. 3 of the report). However, such general policy measures fall outside the scope of this study.

We disregard a minor subsidy to WE improvements in the manufacture of glass (ibid., app. 3, p. 21).

Note also that government support of technological development, research, etc., will be discussed in Chapter 4. Here we are dealing with incentives directly related to the shaping of the WE.

104. Svensk författningssamling, 1974:325.

105. Also cooperative societies and savings-banks the main activity of which were business, farming, or forestry.

106. The upper limit for payments to the fund per company was 70 million SEK.

107. Om statligt stöd till arbetsmiljöinvesteringar, p. 22.

108. Calculation based on information in "Sammanställning av beslut om ianspråktagande av investeringsfonder, särskilda investeringsfonder, arbetsmiljöfonder och vinstfonder, december 1982."

We assume in the discussion of the WE funds that the proportion of applications granted was the same in all years. We also assume that granted and not-granted applications were on average of the same amount.

109. For example, the firm could make payments to an investment fund. As with the WE funds, the amount paid to these funds are tax deductible. The government decides when these may be used to finance investments (any kind of).

See further Södersten (1977), Södersten and Lindberg (1983) and Södersten and Ysander (1984), and the discussion below, pp. 139-140.

110. See n. 108.

111. Om statligt stöd till arbetsmiljöinvesteringar, p. 27.

112. Riksdagens protokoll, Prop. 1975:66, SoU 1975:16, Rskr 1975:191.

For the political background, see Nordfors (1985), section 4.1.

113. Initially 100,000 SEK.

114. This is not the same as the cost to the government of these loans. Interest paid on loans is tax deductible. Consequently, if the companies had paid the interest instead, tax revenues would have been lower.

115. "Komplettering till rapport angående verksamheten med garantilån för arbetsmiljöförbättringar," Statens industriverk, 1979. This includes 1.5 million SEK in non-repayed loans.

116. "Utvärdering av verksamheten med arbetsmiljögarantilån," Statens industriverk, 1978.

117. "Komplettering till rapport angående verksamheten med garantilån för arbetsmiljöförbättringar," Statens industriverk, 1979.

118. This argument was used against WE subsidies in general by the Social Democratic government (Nordfors, 1985, pp. 115-116). I.e. the same government that instituted the WE funds.

119. Again, this was used as an argument against WE subsidies by the Social Democratic government (Nordfors, 1985, pp. 117-118). They also argued that it might decrease other WE investments (ibid.). This will be analyzed below.

120. The decisions on investments in a company are influenced by many factors. All the statements below on the effect on investment decisions should therefore be taken cum grano salis, in particular as regards "productive" investments. The statements also rely very much on the ceteris remaining paribus.

121. This may of course have decreased WE investments everywhere else than in the subsidized companies.

I will not venture into a discussion of whether companies who received these subsidies shared special WE characteristics. In particular, the issue of high-risk vs. low-risk industries will not be entered here.

122. Riksdagens protokoll, Prop. 1974:125.

123. Plastbearbetande industri, pp. 137-138, shows a sharp increase in planned WE investments 1975-1980 in companies engaged in manufacture of plastic products, as compared to such investments 1970-1974. (Based on a questionnaire to the companies in question.) This is suggestive but not conclusive as to the effects of the WE funds. The result cannot be readily "extrapolated" to other industries.

124. The tax is then in effect a tax on profits. Even disregarding the effect of the re-payment in the form of subsidized loans, the effect of such a tax on company investments is not unambiguous. Cf. Atkinson and Stiglitz (1980), ch. 5.

125. However, some results suggest that employee influence on the use of the WE funds was quite limited (Om statligt stöd till arbetsmiljöinvesteringar, p. 121).

126. For example, one argument against WE subsidies was a fear that firms might postpone WE investments until they qualified for a subsidy (Nordfors, 1985, p. 117).

127. If a Pigovian tax is used to achieve an efficient resource allocation, it is essential that the tax receipts are not used to compensate the victim (Baumol, 1972), if the latter can influence the amount of harm done to them.

For this argument to apply in our case there must be a factor in the WE which causes harm to the employees, but would be or is ignored in the negotiations. If the tax is used to compensate the employees they would be too willing to seek employment where this factor exists; they might also take insufficient precautions.

In essence, a tax where proceeds are used to compensate victims poses an analytical problem analogous to strict liability (Brown and Holahan, 1980; Skogh, 1982). It is well-known that the latter kind of system is not efficient in the strict sense when both parties can influence the probability of accidents. (See, e.g., Brown (1973).)

Note that a harmful factor of which the employees are unaware is not relevant here. If employees do not know of the harm, compensating them for it will not change their behaviour.

128. This is extensively discussed in Nordfors (1985).

4 RESEARCH AND INFORMATION CONCERNING THE WORK ENVIRONMENT

In this chapter we will deal with activities to promote research and information in the WE area. Elsewhere in this study, we assume that each agent has a socially optimal amount of information. Here we will discuss the policy measures necessary for this condition to be fulfilled. We will investigate if it appears permissible to treat the agents as optimally informed, given Swedish policy in the area.

The main conclusions are the following:

Specific support to WE research of a basic nature may be warranted. Due to the interaction with other WE policy areas, this also applies to WE aspects of "production research".

No a priori reason has been found for specific support to the dissemination of WE information. However, such a motive is provided by the influence of the Social Insurance system.

Swedish research and information policy is largely consistent with these prescriptions.

The usual problems with bureaucracies may be anticipated. Influence from the demand side will enhance the tendency to increase the budget of the bureau and lead to a lower increase in research for any given expenditure (while at the same time providing valuable expertise).

To identify an optimal amount of research is quite beyond the scope of this study. Instead, we will discuss the more limited question of whether WE research should be given special priority. The WE is but one of many objects of research, and will presumably always receive a part of "unspecified" government funded research. We will discuss whether it is warranted to allocate specific additional resources to this research area.¹

We assume that more informed agents make superior decisions, ceteris paribus. A costless transfer of correct information will thus be to the benefit of the recipient. There are numerous reasons why agents may have difficulties in processing new information, or why they may fail to change their decisions in response to it. One is the existence of cognitive dissonance discussed in section 1.3 (p. 22 sqq.). However these will be disregarded.²

In addition, we assume that the superior decisions that result from more correct information are socially desirable, ceteris paribus. The fact that, for example, general equilibrium, second best, or distributional considerations could have other implications is ignored. The possibility that information makes employees worse off by increasing their anxiety with regards to the present WE will not be discussed here.³

In general, the case for public support of research presents relatively few problems because of the public good properties of knowledge. It is unequivocally socially desirable when the cost that falls on an individual does not exceed the benefits accruing to the same individual. In reality, some people will pay more than they benefit - others less. Furthermore, not everyone benefits from all the various kinds of research, and not all individuals pay for public research.

In many instances, it is impossible to identify the gainers and losers. Or it may be only possible ex post. Given the ex ante setting for our discussion of the effects, these cases are equivalent to one where everyone gains. If it is possible to identify gainers and losers ex ante, research support is tantamount to a transfer from the latter to the former. If such a policy is to be socially desirable additional arguments are required. For example, an acceptance of the potential Pareto improvement criterion (Hicks-Kaldor criterion). We assume in this chapter that this class of policy measures may also be socially desirable. In other words, a research area is not "disqualified" if there are only such measures available. Nor does the existence of such policy measures indicate that the present policy is inoptimal.

Turning to the dissemination of information already produced we face a different situation. It is now a question of whether the individual agent has this information at his/her disposal. "With regard to optimal use, already-produced information is a 'public good' in the sense that its availability to any member of society does not reduce the amount that could be made available to others." (Hirshleifer and Riley (1979), p. 1404) However this does not mean that the spreading of information should necessarily be a public undertaking. For example, it could be argued that the individual agent is in the best position to determine whether additional information is worth the transaction cost of acquiring it.

When looking for arguments for public intervention in research and information, we will not take account of distributional considerations. The arguments are based on the notion of efficiency as commonly understood in welfare economics.

Below, in section 4.1, we will first discuss the case for specific support to WE research. Several arguments in that direction will be shown to exist, particularly as regards research on basic knowledge about the WE. Beginning with a priori considerations regarding the nature of WE information, we will subsequently analyze the influence from other WE policy areas. Similarly, in section 4.2, it will be argued that some public support for the dissemination of information may be warranted. However the case is undoubtedly less clear than for WE research. It stems only from the effect of the Social Insurances.

In section 4.3 we then provide a brief outline of major Swedish policy measures with regard to research and information in the WE area. A significant amount of resources is devoted to this field in Sweden.

The analysis in sections 4.1-4.2 does not suggest the form that public intervention should take. Therefore in section 4.4 an analysis is presented of the implications of the choices made in this respect. In contrast to the first part of this chapter, the analysis in section 4.4 is accordingly in the same vein as that applied in Chapters 2 and 3. Finally some concluding remarks are presented in section 4.5.

4.1 The Case for Public Intervention in the Area of Work Environment Research

To study the case for specific support to WE research, it is first necessary to take a closer look at the case for research policy in general.⁴ Against this background we will then discuss whether WE research tends to be relatively undersupplied. The possibilities of using information generated abroad is then examined. Finally, an analysis is made of the effects of the Social Insurance system and WE regulations on the supply of WE research.

The basic problem is that information as a good has rather special characteristics. This has implications for both production and delivery to consumers. Information has public good properties. Its use by one person does not diminish the amount available to others. However, the degree to which information is characterized by non-excludability varies, since partial exclusion is not theoretically impossible. On the other hand, it is normally impossible to secure total exclusion.

The production of information thus entails benefits external to the producer. These are only to a limited extent "appropriable" (Arrow, 1962). As also emphasized by Arvidsson (1969), this is particularly obvious when you consider that research findings act as an input into future research. The gains from this process, where new research builds partly upon the general level of knowledge in society, cannot be reaped by those who contributed to the state of the science. Furthermore, Arrow argues that an unwillingness to bear risks on the part of investors will discriminate against risky projects. The risk involved in spending on research is generally uninsurable. Markets for dealing with these risks will usually be incomplete because of moral hazard effects, i.e. the lack of incentives for those engaged in the research project that would follow from insurance against risk. This could be important mainly for large projects.⁵

These features of research imply that it would be undersupplied in the absence of public intervention.⁶ One reaction has been to enforce patent laws, whereby the "appropriability" of the positive effects resulting from research is increased.⁷ Others include public production and/or provision of research, and the favourable tax treatment of research expenditure.

At the same time, there can be tendencies in the opposite direction.⁸ We will assume that they do not change the basic feature; i.e. under-provision of research. Nevertheless, they should be noted. First, there is the possibility of wasteful parallel research.⁹ As formulated by Hirshleifer and Riley (1979), it is not feasible to grant property rights for the right to engage in search of an idea. Therefore there is an obvious possibility that "too many" engage in search of the same idea. Indeed, Tandon (1983) has shown that this may also result in too much knowledge being produced. Secondly, Hirshleifer (1971) has argued that "... an inventor might be able to speculate by taking long or short positions in assets whose value will be affected by the invention ..." (Hirshleifer and Riley, 1979, p. 1405). McFetridge (1977, p. 15) argues that this effect is unlikely to be quantitatively

important, because 1) the same kind of possibilities arise from many other activities, 2) there is in reality very little truly "inside" information, and 3) it is costly to exploit such information on a grand scale.

From the considerations above it follows that public intervention will be more essential with respect to some kinds of research than others. The discussion below follows the division of research into pure basic research, oriented basic research, applied research, and development (cf. Annerstedt, 1972, pp. 189-191). In the absence of public intervention, private initiative would produce very little pure basic research, since it is the form of research that has the least appropriable benefits (Arrow, 1962). There would be a wide gap between the amount actually produced and the amount that is socially optimal. This gap would be relatively smaller, though still substantial, for oriented basic research, of which we would expect relatively more to be privately produced. There would be a substantial portion of the socially optimal amount of applied research even in the absence of public intervention, and this holds to an even greater degree for development.

This implies that one needs a general research policy to reach the socially optimal amount of information production, and that this policy should be constructed to fill these varying gaps for different kinds of research. (Much pure basic research, relatively less oriented basic research, etc.)

Is Work Environment Research Relatively Undersupplied?

The above discussion spells out the case for public support to research in general. Given that we do have a general research policy, that is structured in the way indicated above, what reasons can there be to direct specific resources to WE research? Given the present perspective, this could be the case when less WE research is produced by private initiative than other research of a similar kind (oriented basic WE research as compared to other oriented basic research, and so forth). To mitigate this tendency it might be necessary to implement specific policy measures.

The question we are addressing is thus whether WE research would tend to be relatively undersupplied compared to other kinds of research.¹⁰ If that is the case, additional resources specifically directed to WE research would be needed, in order to provide agents with an optimal amount of WE information. Specifically, we will investigate if there is need for permanent support in this area; i.e. viewed in a perspective of more than ten years, say.¹¹

Before we probe deeper into these matters, it is useful to differentiate between three kinds of WE research:

- (1) Research regarding "basic facts" about the WE, such as health risks of a particular substance or what makes a WE socially agreeable.
- (2) Research on "WE equipment", such as safety devices, and adaptations of existing technology; research on equipment needed for the enforcement of WE regulations.
- (3) Research on production processes that entail changes in the WE.

The first category includes oriented basic research, and some applied research. Categories (2) and (3) include "development", and some applied research. Obviously, there are no sharp distinctions in this area. Nor do we propose that these categories suit all aspects of WE research. However, we do argue that they capture the essence of much of what is going on, particularly as regards research connected with the physical shaping of the WE.

We first note that in this context type (3) research has two noteworthy characteristics. First, it is hard to distinguish these expenditures from other spending on research (a parallel to the problem with support to WE investments, see Chapter 3). Secondly, this kind of research can to a large extent only be conducted at the company level. An efficient innovation process requires that the WE features of new techniques, etc., need to be considered from the first stages of their development. The policy in this case would therefore tend to involve support to all company research. However we are then outside the scope of this analysis, which is limited to the question of providing special support to WE research. Nevertheless, some projects supported by the ASF appear to belong to this category.

Type (1) research above is the one that comes closest to being a public good. For our analytical purposes, it shares many of the features of pure basic research. The gains in our case are probably less appropriable than for other similar kinds of research. It is not possible to collect from people using the knowledge that asbestos is dangerous. Patent rights are typically not enforceable for such information. The general tendency is reinforced here because benefits cannot often be reaped from this information without its disclosure. If a safer workplace is established in the hope of reducing wage costs or other employee compensation, the information has to be made publically available. If one succeeds in reducing absenteeism, the information will undoubtedly leak out. The same would apply to other WE improvements that increase productivity. Furthermore, very little (if any) of this kind of information is "firm-specific."¹² As we shall see below, the tendency to undersupply this kind of WE research is strengthened by the influence of other policy measures. It may be concluded that this research would be relatively undersupplied in the absence of additional public support. However the magnitude of this support may be quite modest. The relative under-supply will take place in the private sector. A lot of research in this category will take place in the public sector anyway.

Regarding type (2) and type (3) information, it is possible in principle to grant patent rights and thus increase "appropriability."¹³ Thus, one might expect here to encounter the trade-off sketched by Arrow (1962) between inoptimality in the form of under-supply and inoptimality in use.¹⁴ The latter arises when you increase appropriability. You then restrict the use of information even though the opportunity cost of one more person using it is zero.

However, Arvidsson (1969) notes that when new information takes the form of a product innovation, the latter inoptimality disappears as soon as production is started.¹⁵ (The price of the new product may be "too high", but that is another problem.) He discusses pharmaceuticals, but the same argument applies to research type (2) above on WE equipment. Thus in this case there is only the tendency to undersupply research. This can be partly off-set by patent laws. It should be clear from the discussion above that there will always be some positive externalities that cannot be appropriated.

At the same time, there is a tendency towards over-investment in this kind of research. First, there is the possibility that several companies try to make the same invention. This could lead to an excessive level of total research expenditure in this area.¹⁶ Secondly, competitors may try to circumvent a patent by developing a close substitute to the product in question. This may well be privately profitable even if the improvement of the product thus accomplished is of negligible (if any) value to the buyer. The social costs of the invention then exceeds the social benefits (Arvidsson, 1969).

When WE research takes the form of a joint output of research on production processes and the like (type (3) above), the problem with inoptimality in the use of information remains.

From this discussion it may be concluded that there do not appear to be any grounds for treating WE research types (2) and (3) any differently from other company research.

The conclusion thus far is that type (1) WE research should probably receive special public support. It has also been argued that types (2) and (3) should not be treated any differently from other company research - it follows that it should be supported only to the extent that similar kinds of "private" research receives public backing.¹⁷ This is what can be said a priori without empirical estimates of rates of return. There are, of course, formidable obstacles to making a reasonable accurate estimate of future rates of return to research projects. "Probably all that could be hoped for is the estimation of future rates of return from those in the past" (Arrow, 1962, p. 623).

The International Perspective

Sweden is a small open economy, and this must be considered when discussing research policy. There will of course be the same kind of free rider problem globally between nations as within a particular country. In general any country can pursue a policy of using information generated abroad instead of spending resources on domestic research.¹⁸ Such a policy may include the purchase of human capital from abroad. However, if pursued consistently the latter kind of

policy is very likely to result in repercussions. Therefore, we will deal only with information transfers, which are much less likely to trigger counter-actions.

The extent to which this is a feasible strategy will vary greatly between countries. It will be argued below that Sweden should not devote a significant amount of resources to specific policy measures of this kind in the WE area.

There are a number of reasons why we need domestic research in this field. First, there is a general need for at least some research in all relevant fields, in order to create the domestic competence required for valuation and adoption of the results of foreign research. Secondly, we need research on work conditions that are specifically Swedish. Thirdly, there are areas where Sweden is among the leading nations in technological development. It will probably not be advantageous to wait for WE information to emerge from abroad when this is the case. Fourthly, to the extent that we want to push harder than other nations for either general or specific WE improvements, it will probably be necessary to rely on domestic research. There will generally be a tendency for this to take place since Sweden is among the richer nations in terms of per capita income. This also limits the number of countries from which "information borrowing" is a feasible option.

Notwithstanding these limitations, it seems natural that we would want to make extensive use of information generated abroad. However, a feature of almost any normal research is that the researcher will maintain close contact with international progress in the field. International results are introduced as a bi-product of domestic research. Given the need for the latter outlined above, it seems likely that creation and maintenance of this informal information transfer (through support of domestic research) is cost-effective in relation to major formalized policy measures.

This is not to deny that there might be some scope for such measures. The limited activities of the ASF in this field could well be socially desirable.¹⁹ Any conclusion must be deferred, though, pending the admittedly difficult task of empirical appraisal.

The informal information transfer in itself can hardly be improved upon by policy measures. One will have to be content with a general recommendation to research funding authorities to keep in mind its importance.

Influences of Other Work Environment Policy

At this point, we must take into account the interactions between WE research and other kinds of WE policy. The previous discussion of a priori arguments has neither taken Social Insurances nor WE regulations into account.²⁰

We have already seen that the individual company inevitably can only reap part of the benefits from WE research. This effect is strengthened by other policy measures. The costs of occupational injuries in particular and absenteeism in general are, due to the Social Insurance system, only to a limited extent internal to the company. This has implications for the privately conducted WE research. First, it does not pay as much as it would have for a company to devote resources to finding processes, etc., that have "good" WE characteristics. Secondly, it does not pay to identify what constitutes a good WE in these respects. Thirdly, there is less demand for safety equipment etc. Thus the profitability of engaging in production or research of such devices is decreased. This latter effect is countered, however, by the "demand-increasing" property of regulation (cf. below). It is not possible a priori to ascertain which effect will be the strongest. However it seems certain that the composition of demand will change.

This brings us to the WE regulations. The choice of instrument in WE policy is of importance for both the level and direction of private research efforts.²¹

A common complaint is that regulations lead to defensive and unproductive activities. Even if this is not the case, regulations will usually increase company costs in a number of ways, including the cost of innovation. In both instances, resources may be taken away from research and development. (See Ashford, Heaton and Priest (1979) for a more extensive discussion of these issues.) Unfortunately it

appears impossible to tell if this has been the case; or how any decrease has specifically affected WE research.

Another effect of regulation that may lead to a decrease in research is that the threat of future regulation increases the riskiness of any investment, including research (Eads, 1980). On the other hand, Eads suggests that "Regulation may [...] increase the pay-off to basic research." (Eads, 1980, p. 53.) For example, "Chemical firms, [...] now want to stay abreast of research that can overnight direct the regulatory spotlight at important segments of their business." (Op. cit., p. 53.) In other words, there is a market risk connected with other research projects that stems from the presence of WE regulations. This is decreased by WE research. Thus here we have two countervailing tendencies that influence spending on WE research. A priori, it is not possible to predict which one would be the strongest.

Regulations will also increase the demand for "compliance technology", and for "enforcement technology" (Ashford, Heaton and Priest, 1979), corresponding roughly to my category (2) WE research above. This will favour research in such areas.²² Of more fundamental importance may be the indirect or leveraged effects of regulation. As noted in Chapter 3, Ashford et al. (1980) argue that regulations will affect the path of technological development. The demand for a safer WE as represented by regulations could thus change the direction of research efforts. For this to happen, it is essential that the regulatory signal entails a high probability that increases in WE quality will be demanded. It is an open question to what extent such an effect will follow from the Swedish regulatory effort.

To the extent that regulations are applied uniformly, some research efforts in regulated areas might be misallocated. The regulation cannot then be expected to pinpoint the most cost-effective way of improving the WE for each particular firm.

To sum up, in comparison to research, the overall effect of WE regulations would seem to be in favour of other kinds of investments. However, this general effect is less clear for WE research. We have noted 1) the increased pay-off to type (1) WE research, 2) the demand for compliance technology, and 3) the possible indirect effect on the

direction of technological development. In addition, there is the possible misallocation due to uniformly applied regulations. The total effect could in fact be more WE research than in the absence of regulations.

We must add also the effect of the Social Insurance system, that generally lowers the (private) return to WE research. From a theoretical point of view, it seems likely that the combined effects of the Social Insurance system and WE regulations is to decrease privately financed WE research types (1) and (3). (Any definite conclusions would have to be backed by empirical evidence; something that will not be attempted here.)

It is now time to summarize the arguments for particular measures aimed at WE research. We argued before that specific support to type (1) WE research may be justified by the nature of that information. Here this case is strengthened by the influence of other policy measures.²³ It is also suggested that WE research type (3) should be supported.²⁴ As noted before, this could lead us to support all company research. (This implies the over-supply of the other kinds of company research.) "Special treatment" of this category is usually difficult. By far the easiest way would be to reverse precisely those policy measures that lower the return to this kind of research.

4.2 Information Processing

Once the information exists somewhere in the country, we must then consider its transfer to the relevant decision-making agents. This would be no problem if the process was costless. Information could then be made immediately available to everybody, in the same way that the benefits of defence automatically falls on every citizen. However this is not the case. If decisions are to be based on more accurate information, then someone must bear the burden of the transaction costs. In this section, we will discuss the rationale for specific public intervention in the dissemination of WE information.

Companies need general WE information and information about the individual employee. The latter also needs general WE information and moreover need to know about the WE of individual companies.²⁵

With rational agents, there is hardly any a priori efficiency argument for government intervention in the dissemination of WE information.²⁶ (Over and above what is deemed necessary for similar kinds of information.) There are in all probability increasing returns to scale in gathering, valuation and dissemination of information. Specialization entails comparative advantage. We therefore expect cooperation among agents and/or information entrepreneurs.²⁷ The individual agent will then determine if additional information is worth its (transaction) cost. It could be argued that this choice will be inefficient, because one does not know what one is buying (Arrow, 1962). However, it does not follow that anybody else will be better equipped to make this decision.²⁸

For consumers one could perhaps argue that cooperation is impossible and that the Swedish market is too small for entrepreneurs. However, the degree of organization in the Swedish labour market makes cooperation in informational activities quite possible. It is also relatively easy to identify prospective buyers of information, which increases the opportunity for entrepreneurs to establish themselves.²⁹

However, the Social Insurance system lowers the private return to information seeking activities. This will affect the general WE information of agents, as well as employers' and employees' knowledge of each other. Thus it becomes less likely that employees are efficiently allocated between firms and jobs. We have here an argument for a public policy that increases the information available to individual agents.³⁰ Note that even if this policy only leads to a direct increase in general WE information, it will also indirectly increase the parties knowledge of each other. The usefulness of the latter kind of information increases with the amount of general WE information available. Thus the parties will voluntarily seek more information about each other when the amount of general WE information is increased.

In addition, as argued above (pp. 146-147), an experience rated insurance system would have produced valuable information. Namely, the injury record, and thus the WE quality, of individual firms.

However from a public policy point of view one could find additional reasons for intervention. Agents may be considered to be irrational, in the sense of not seeking "unpleasant" information that it would be to their advantage to possess. (Cf. the discussion of cognitive dissonance in section 1.3.) It may be considered too "risky" (or otherwise undesirable) to rely on the "market" to provide information. One could also put forward distributional arguments. Possession of information will influence the bargaining position of the parties on the labour market. If one party tend to be less well-informed, they would stand to gain from public dissemination of information.

Now suppose that it is decided that one should intervene to ensure that individual agents receive more information. There is in principle two ways of going about it. One is to make dissemination of information a public undertaking.³¹ The other is to increase the incentives available to individuals for the collection of information. The latter method induces them to become better informed, by making it more costly to remain ignorant. Naturally the choice of method has distributional consequences. As we shall see, Swedish policy utilizes both methods.

4.3 Publicly Financed Work Environment Research and Information

After the theoretical discussion, it is now time to take a look at Swedish policy measures in the research and information area. Let us first note that there is an extensive general research policy in Sweden. A considerable amount of public resources is allocated to universities and other research institutions. Total government expenditure for R&D in 1984/85 amounted to approximately 10,200 million SEK.³² We make the simplifying assumption that this general research policy fulfils the requirements indicated at the beginning of the chapter.

An important part of Swedish WE policy is the financing of research and information activities. It is impossible to give any exact figures, but in Table 4.1 we have collected some relevant statistics.³³ In view of the concentration on physical aspects of the WE, it should be emphasized that no separation into different kinds of WE research is attempted in this table.

Table 4.1: Government expenditures related to work environment research and information (million SEK, current prices, source in brackets)

	Expenditure
Expenditure specifically directed to WE research in 1984/85* (1)	221
as percentage of total research expenditure (1)	2.2%
Expenditure specifically directed to WE research in 1985/86* (2)	261
of which financed by the ASF* (2)	189
of which at the ASS* (2)	67

The Swedish Work Environment Fund (ASF), total budget in 1983/84 (3)	497
of which from payroll tax (3)	420
of which from rent on capital (3)	69
The National Bureau of Occupational Safety and Health (ASS), total budget in 1983/84 (4)	151

* This figure is necessarily only a rough estimate. Furthermore, it should be noted that it is a forecast.

Sources:

- (1) "Statliga anslag till forskning och utveckling 1984/85," Statistics Sweden (Bergström-Balkeståhl, B.)
- (2) Information received from Birgitta Bergström-Balkeståhl, Statistics Sweden, September 1985.
- (3) Vår verksamhet 1983/84, Arbetarskyddsfonden.
- (4) Arbetarskyddsstyrelsen och yrkesinspektionen 1983: Verksamhetsberättelse.

Government expenditure totalling 261 million SEK will be directed to specific WE research in 1985/86. In 1984/85 the corresponding figure was 221 million SEK. This represented about 2.2% of total government spending on research in that year. Obviously, this represents only a minor part of the government supported research that is in some way related to the WE. For example, much of the research in the field of health and medical care is directly or indirectly related to the present or future WE. Government expenditure directly specified for that area amounted to 1,337 million SEK in 1984/85.³⁴

If we widen the perspective to also include information dissemination and education regarding the WE, additional resources are involved. First, the Swedish Work Environment Fund (Arbetarskyddsfonden, ASF) is dominant in the field of financing research, education, and information regarding the WE and working life generally.³⁵ It is totally financed by a 0.155% payroll tax.³⁶ In 1983/84 this raised an income of 420 million SEK, to which is added inter alia interest of 69 million SEK. (Not all of this, however, is used in the WE area in a narrower sense.)

Secondly the National Board of Occupational Safety and Health (Arbetarskyddsstyrelsen, ASS) also plays an important roll for research, education and information in this field. In addition to general activities of this kind, the ASS together with Statistics Sweden (formerly the National Central Bureau of Statistics) is responsible for the production of statistics on occupational injuries. There is also medical research at the ASS; the unit for occupational medicine is the major one in the country with some 300 employees.³⁷ The total budget of the ASS was approximately 150 million SEK in the year 1983/84. Finally, the provision of information to employers and employees is an important function of the Labour Inspectorate (Yrkesinspektionen, YI). In 1983 employees of the YI held 5,500 lectures and took part in 29,700 conferences and consultations. (To be compared with 55,100 inspections at work sites, for example.) The expenditure on information and education performed by the YI amounted to around 13 million SEK in 1983 (cf. Chapter 3, n. 19).³⁸

We see from the above that no matter how we choose to define it, a considerable amount of public resources are devoted exclusively to research and information concerning the WE. The Swedish solution in the area of information dissemination is in fact twofold. We have seen that one endeavours to spread information through collectively financed institutions. In addition, the AML stipulates that it is the responsibility of the company that employees are adequately informed about risks.³⁹ There are also many regulations concerning the marking of dangerous material and equipment.

4.4 Effects of the Present Research and Information Policy

In section 4.2 we discussed the arguments for government support to WE research. We found that research concerning basic facts about the WE should receive public support. It might well be characterized by the "inappropriability" of its benefits to an even greater extent than other similar research. Research concerning WE equipment and production processes should arguably receive support in so far as similar kinds of research receive favourable treatment. However, we also found that the Social Insurance system leads to the underprovision of WE research compared to other research. On the other hand, regulations will increase research on compliance technology. This leaves us with a case for support to basic WE research and production-related WE research.

However no policy prescription on the form public support should take can be derived from this discussion.⁴⁰ If we disregard policy changes in other areas, there are two basic possibilities: public provision and public production.⁴¹ In the former case, the production of information is left to private enterprises.

In either case, research may be directed or non-directed. The term directed research refers to situations where general support is not given to research in the WE area. Instead, support is provided to specific projects or sub-areas. This distinction is obviously a matter of degree.

In this section, we will first discuss the effects of the precise form chosen for public policy in the area of WE research. The main point of comparison is then the other possibilities available for research support. Similarly, we will then consider the effects of the kind of (dissemination of) information policy that is adopted. As elsewhere in this study, we focus on the structural properties of the system.

Effects of the Work Environment Research Policy

Direction of Efforts

The provision of public support to WE research in Sweden has mainly taken the form of partial or total financing of research projects. (It should be remembered that our focus is on research concerned with the physical shaping of the WE.) It partly takes the form of public production as conducted within the ASS.⁴² This research is basically non-directed. The other major source of specific support to WE research is the ASF. In this case, it is mainly directed private research (public provision), as it consists of particular research projects being approved and financed by the ASF.⁴³

We look first at the direction of these efforts. The ASS is mainly concerned with research on basic facts about the WE. The ASF on the other hand divides its resources inter alia between research of this kind, research on WE equipment and the adaption of existing technology, and research on "enforcement technology". Among the projects supported there are also some that could be characterized as production process research.⁴⁴ A highly tentative distribution of projects at the ASF between different research categories is presented in Table 4.2 (with a liberal interpretation of categories (1)-(3)).

The support for basic research makes good sense in view of our discussion above. However, it is not as obvious that research in the area of WE equipment should receive financial backing, over and above that accorded to other product innovations.⁴⁵ The same is true of enforcement technology. The following effects may therefore be noted. In the case of compliance technology it entails a subsidy to the regulated industries, and to the producers of the equipment in

question. In addition this could give a bias to production process research in the direction of processes that have negative WE characteristics that are correctable by later additions or adaptations, as compared to processes that are free of these characteristics. The support to research on enforcement technology implies a subsidy to the producers in question, ceteris paribus.

Table 4.2: Percentage distribution of funding of research projects financed by the ASF 1983/84

Research category	Percentage of funding
(1) Research regarding "basic facts" about the WE	62
(2) Research on "WE equipment", and adaptations of existing technology	25
(3) Research on production processes that entail changes in the WE.	6
(4) Other	7

Note: These figures refer to projects which were given approval or continued finance between January 1, 1983, and June 30, 1984. Only projects concerned with the physical shaping of the WE are included (pp. 12-146 in Projektkatalog 1983/84). The lump sum payments from the ASF to the ASS are excluded (in 1983/84 amounting to 20 million SEK), as are also projects that officially are categorized under "physical" factors, but rather belong to other areas, such as information dissemination.

This brings us to the question of the selection of projects. Lindsay (1976) predicts that government enterprises will tend to produce relatively more of outputs that are easy to measure, and too little of "invisible" outputs. In our case this would imply a concentration on applied research, or research to deal with a particular problem, that will have a clear short term benefit.⁴⁶ Moreover, a bias of this kind is in fact incorporated in the directives under which the ASF operates. It is stated there that for research sponsored by the fund, priority should be given to projects that will have "practical applications" or lead to new technical solutions being put into use. It is hard to justify this restriction on efficiency grounds. One

would have to assume that "free" WE research is biased in the other direction, to such a degree that it more than counteracts the bias inherent in the organization of the research. This does not seem realistic.

Finally general measures exist to support company research. We will not endeavour to analyze whether this brings the supply of production process related WE research to a proper level.⁴⁷

Centralization of Efforts

A salient feature of the present system is that resources are distributed through a relatively centralized publicly administered organization. This centralization has certain implications. Its virtue is that it increases the opportunity to avoid unnecessary parallel research. On the other hand, there are some possible disadvantages.

One important theme in the critique of oriented research as such, is that important issues might be overlooked because they do no "fit" into any of the fields of priority.⁴⁸ It seems probable that this risk of too little diversification is enhanced by the present centralization. The predominant view within these organizations about what is important will have a major impact. However to the extent that this is realized the opportunities for counteracting such tendencies are at the same time greater. This is explained by the clearer view that is obtained of what is going on.

A related issue is the fear that the freedom of research in general and the possibility for "critical" research in particular will be circumscribed through the expansion of oriented research.⁴⁹ It is to be expected that there will be relatively little interest in research that explicitly or implicitly questions the role of these organizations. This aspect is an example of what Stevrin (1978) calls coordination for control instead of coordination for development.⁵⁰

In other words, it is implied that the very possibility of greater intra-sectoral coordination may prove to be a disadvantage.⁵¹ However to the extent that WE research conducted independently of this system can fill the gaps, the problem disappears.

Efforts Directed by Public Agencies

Now we turn to aspects connected with the fact that public agencies specifically created for the purpose are administering this research. The only alternative that could totally have avoided this is non-directed private production (public provision). Since this solution has not been chosen, a number of "bureaucratic" effects may be present.

Let us first note along with McFetridge (1977, p. 9) that there is no presumption that government officials will be more efficient than a private enterprise in monitoring the work of researchers. Secondly, it is a common assertion that public officials will try to choose an overoptimal level of activity for their agency. In other words, the activity will be increased to a point where social costs exceed social benefits at the margin. Furthermore, there is generally no competitive pressure on the employees of the "bureau" to be efficient, and "... public bureaucrats' salaries are either unrelated or indirectly [...] related to improved efficiency. Thus the public bureau is characterized by weak external control on efficiency and weak internal incentives." (Mueller, 1979, p. 158.)⁵² The seminal work in this area is of course Niskanen's (1971) who predicted that the bureaucrat would be a budget maximizer.⁵³ The bureaucrat can indulge in this type of behaviour because his employer - the government/politicians - cannot observe the actual output of desired products, but must infer this from the activity level of the bureau. Thus, in our case, what can be easily observed is the budget of research projects, agencies, and departments. What is not so easily observable is the production of "better knowledge" on which to base WE decisions.

Another tendency can be seen as a variant of the diversification problem discussed above. One aspect of a bureaucratic incentive structure is that it discourages risky projects, venturing into new fields, breaking with tradition, etc. Whether this is a problem depends on the structure of pure WE research.

Some of the problems with centralized decision-making that take place in bureaucracies could in principle be mitigated by introducing competition among bureaus, and allowing private market alternatives. (One could also encourage the undertaking of risky and unconventional projects.) These measures were suggested by Niskanen (1971). The reward to individual officials must also be related to the performance of the bureau, something which is admittedly difficult to bring about.

That such a system can lead to efficiency gains is substantiated by Swedish experience. Jonsson (1985) presents the effects of introducing competition among the agencies administering a large part of the Social Insurance system (försäkringskassorna). These agencies are all part of a monopoly organization, but by introducing official comparison of their performance (productivity), they are provided with incentives for efficiency. There is an implicit understanding that

promotion possibilities will be dependent on the outcome of this comparison (Jonsson, p. 14). This has led to marked productivity increases.

It is important to note, however, that the output in this case was not a public good. Therefore, it does not automatically follow that such a system is suitable for information production.⁵⁴ Ruttan (1980) discusses the present evidence for agricultural research. He suggests, that in the USA, a competitively organized system for collectively financed research has seemingly led to under-investment in research. This is due to the usual problems associated with "private" production of a good with non-excludable benefits. (Or alternatively this has aggravated a problem caused by spill-over effects, etc., among nations.)

At the same time the system described by Ruttan is relatively efficient in the allocation of resources for research. He argues that this property may well be lost with a more centralized system. Thus one is faced with a choice between Scylla and Charybdis.

User_Influence

Niskanen also noted that the construction of the institutional framework is important. If those users who have a high demand for the output of the bureau can influence the assessment of the bureau's performance, this will strengthen the tendency to increase the budget of the bureau to above-optimal levels. (This is in addition to the customary pressures available to interest groups.) Stevrin (1978, p. 255) concludes that oriented research in Sweden is usually governed by the users. Their representatives are in a majority on the boards for oriented research. The WE area is no exception. Employers' and employees' representatives are in a majority on the boards of the ASF (12 of 14) and the ASS (7 of 11).⁵⁵

To the extent that the users can influence the direction of research activities, it is to be assumed that priority will be given to areas that are considered most valuable from their point of view. Projects that would have been undertaken by private initiative in the absence of collectively financed WE research will probably be among the first projects to be selected. One will favour those who would otherwise

have financed research in this category. Furthermore, collective financing of projects that would have been undertaken anyhow does not increase the amount of WE research.⁵⁶

If one tries to reduce user influence one is again faced with a difficult choice. With the present system at least some inside knowledge is transferred to the resource allocation agency. This may obviously be of great value, ceteris paribus.

Effects of the Policy Concerning Dissemination of Information

We now leave the question of research and information production, and turn instead to the dissemination of existing information and knowledge. (Collecting and publishing WE information, giving courses, etc.) This service is to a very large extent performed by the same government agencies.

The fact that dissemination of information is encouraged by public policy has implications in itself.⁵⁷ It is arguable that employers have superior access to certain kinds of information in the WE area in relation to employees.⁵⁸ For example, a considerable amount of knowledge follows as a bi-product of "ordinary" company research and development. To the extent that this is so, the public policy will probably be to the advantage of employees in their bargaining with the employer. (This is not to deny that employers may also gain from the provision of information.)

We turn to the form chosen for the publicly disseminated information. This certainly must command all of the benefits from economies of scale. We might in fact have reached a point where the organization is so large that there are diseconomies of scale. Furthermore, we might expect bureaucratic effects, as discussed above in relation to research policy. The user influence has the same implications as in that case. The emphasis is likely to be on the privately most profitable information, which also means that the total effect of any given expenditure is less marked. There is also the positive effect of inside information.

We encounter here another variant of the diversification problem due to centralized decision-making under uncertainty. This arises because one cannot collect all information; and one cannot publish, etc., all that is collected. Both these processes entail selection and condensation of results. Thus, new information is again produced;⁵⁹

namely which part of current knowledge is important in relation to the WE. The risk here lies in the fact that (almost) everybody will adopt the conclusion arrived at by the central agency as a dictum on the true state of the world. Therefore, if something goes wrong, it can go very wrong. Let us take an example. One of the most important decisions in the processing of WE information is to determine how dangerous different substances are. If we have only one information unit and it makes a mistake, then everybody will base their decisions on incorrect information. If we have instead a number of evaluating units, they will probably come to (at least slightly) different conclusions. It is possible that some are correct and some wrong, which could lead to a better outcome in the individual case. Depending on the probability distributions, there might even be an overall welfare loss associated with centralized information processing.⁸⁰ The social evaluation of these different outcomes depends inter alia on the degree of risk aversion involved. There are of course ways of mitigating these effects; for example that the central agency emphasizes that all this kind of information should be interpreted as a continuum of probabilities, instead of as discrete standpoints on harmfulness.

As noted by Ståhl (1972), the common WE policy of regulation with specific standards can be interpreted as a cheap method of dissemination of information. In this function it has the same properties as the method discussed above.

There are two implications of the stipulations in the AML. The employer must become informed, in order to be able to inform the employees. Thus the employer must first seek information. This information should then be presented to the employees. The expenditure for both processes falls on the employer. For the latter information transfer (to employees), we could expect cost shifting as with other WE regulations. (The reader is referred to the discussion in sections 3.3-3.6.)

The system entails no direct incentives for employees to become better informed. However, by making information more readily available, the policy indirectly induces them to seek more information. (The marginal return to such activities is increased.)

We noted above that publicly provided general WE information will also increase the parties knowledge of each other, albeit indirectly. The AML adds to one side of this by making it compulsory for companies to inform employees about their workplace. Note, however, that this does not directly increase the knowledge of prospective employees.

4.5 Concluding Discussion on Research and Information Policy

We have now discussed the public policy necessary for agents to have a socially optimal amount of information. Given the institutional framework, it appears that research on basic facts about the WE and dissemination of information needs some encouragement. In addition, all company research would have to be supported to increase such WE research as is indistinguishable from "ordinary" technological development.

We then studied the Swedish policy in these areas.⁶¹ Public resources are directed specifically to WE research. In particular, it is reasonable to see the activities of the ASF as an indication that relatively more resources are devoted to WE research than to other areas. However, three qualifications to this statement must be noted. On the one hand, government funds in support of research flows through many channels, and we will not endeavour to present a comprehensive survey and analysis.⁶² On the other hand, the expenditure from the ASF represents the upper limit for the increase in research that ensues. There are two crowding-out effects here. Privately conducted WE research may decrease, as discussed in relation to user influence. Furthermore, WE research in universities and other public organizations that would have taken place anyway will now often be financed from the ASF. (46% of research projects financed from the ASF in 1983/84 were conducted within universities.⁶³)

As we have seen, information dissemination in the WE area is also encouraged. In conclusion, I would argue that the present policy ensures that individual agents have (at least) an optimal amount of WE information. Our assumption appears to be reasonably well justified.

Notes to Chapter 4

1. This also raises the question of oriented versus pure research. However, we will not enter the debate on the desirability of oriented research in general. See e.g. Annerstedt (1972) and Stevrin (1978) for a general discussion of Swedish research policy.

2. See Leyman (1982) for a discussion of such aspects in relation to occupational hazards. Obviously, such factors may very well affect the benefits from research and information policy.

3. That there is such an effect is suggested in Lyttkens (1982), pp. 60-61, and in Viscusi (1979a), chapter 5 and (1983b) p. 171.

4. We assume that the rate and direction of inventive activity and other production of information is influenced by economic factors. See McPetridge (1977, pp. 4-5) for arguments to substantiate this claim.

5. As a result, it appears that "... firms generally undertake major projects only after earlier research has reduced the technical uncertainties." (Braunstein, Baumol and Mansfield, 1980, p. 21.)

6. Hirshleifer (1983) has shown that the under-supply of public goods is aggravated where the socially available amount is the maximum of individually supplied quantities. This may apply to some research situations, where a new discovery is contingent upon some agent devoting a large amount of resources to a single end.

7. According to Braunstein, Baumol and Mansfield (1980) it is not clear that patents have served as an effective stimulus to R&D outlays by firms. However it may have stimulated individual inventors. Patent laws may also have encouraged disclosure of new inventions (ibid.).

One reason for a limited stimulus of patent laws may be that licensing increases the profitability of not winning the patent (Shapiro, 1985).

8. Also, Arvidsson (1969, pp. 178-80) shows that for product innovations, differences in the relation between price and marginal production cost in different lines of production can imply both the under- and over-provision of research. If new products generally are substitutes for already existing ones, the production of which is characterized by $p > MC$, then this implies over-supply.

9. See, for example, Arvidsson (1969, p. 180), Hirshleifer and Riley (1979, p. 1404-05), and Usher (1964, p. 287). A recent contribution is Tandon (1983).

10. It may be that WE research is in substantial need of an interdisciplinary approach. If so, this could mean that it is relatively undersupplied, because this may tend to be the case for interdisciplinary research generally (cf. Lundahl, 1985). However, WE research would certainly not be alone in this category. The argument would also appear to be most relevant for basic research.

11. Thus we are not concerned here with temporary "disequilibria" in the distribution of research efforts. It is to be expected that different areas will be relatively undersupplied with research in certain periods. This may require temporary actions from the government. Also, certain areas may lack a basis in the scientific community from which expansion could develop. (This is particularly likely in a small country like Sweden.) Again, this would require specific support during an initial phase. Note that temporary disturbances can work in the opposite direction too. It may become à la mode to do research on certain issues, so that an area is relatively oversupplied for a while. (This is probably also more likely in a small country.)

12. Some of it is industry-specific, in which case there is scope for joint research institutes. However, much research is relevant for large parts of the economy. There may also be a problem of free riding within industries.

13. There is no clear a priori case for any specific relation between the appropriability of new products and new processes respectively (Mansfield et al., 1977). This is an empirical question. In the absence of such evidence nothing much can be said on the social rates of return to supporting these kinds of research.

We will not discuss the issue brought up by Berkowitz and Kotowitz (1982); namely that the optimal patent policy is influenced both by country size and market structure in the innovation market.

14. We note in passing that this problem disappears - also in the case of basic research - in the case of unlimited property rights (patent grants) coupled with perfect price discrimination. See, for example, Hirshleifer and Riley (1979, p. 1404), and McFetridge (1977, pp. 8-10).

15. This assumes that it is profitable to start production on a large scale. It may happen that the equipment is only produced for internal use.

16. The existence of parallel research does not necessarily imply over-supply. Stern (1981) shows that risk aversion can also change the picture to one of too small total expenditures in this case. Nelson (1961) shows that parallel inventive efforts may be efficient when it is not known which is the best path to a given objective. He argues that similar considerations may apply with respect to different inventors who try to satisfy the same potential demand. The result that duplication of research is not necessarily wasteful is derived in Tandon (1983).

17. We noted in Chapter 3 that the compensation for negatively valued WE characteristics may be far from "perfect". This market imperfection implies that less will be spent on WE research. However this cannot directly be used as an argument for public intervention in WE research. First it would be necessary to evaluate the degree of imperfection in all other markets, and the implications for other kinds of research. This is beyond the scope of the present study.

18. Thus, research might be globally undersupplied. I will not dwell on this aspect since it falls outside the scope of this study. In addition, it would to a large extent be a parallel to our previous discussion. The strength of different tendencies might change, though. For example, patent rights are less enforceable, and parallel research is more likely to occur.

19. See Arbetsarkyddsfondens verksamhetsberättelse 1982/83, pp. 34-35.

20. In addition, other "market imperfections" can also influence the return to research investments. Eads (1974) has noted that, for example, other types of government interventions can increase the profitability of different kinds of research. We will not consider such influences here, nor the general relationship between market structure and R&D efforts.

21. In general, we would expect all regulation to influence these variables in a number of ways. However we will confine our attention to the impact of WE regulations. This is not to deny that non-WE regulation can influence WE research, but these effects are probably of minor importance.

22. See Manners and Nason (1978) for some empirical observations in this line.

23. However this argument is not unproblematical. Certainly the Social Insurance system lowers the amount of private research. At the same time, however, it changes the incentive structure, so that public provision of the same research may fail to affect the decisions taken by firms and employees.

24. A major caveat must be noted. Analyses of other policy measures and other kinds of research might reveal similar effects, mutatis mutandis. Finding that practically all kinds of research merits specific support would eliminate the case for special treatment of any one of them.

25. Companies may volunteer some information to employees. Cf. Chapter 2, n. 57.

26. In contrast to the view expressed in an official investigation, viz.:

"If the proposed measures [to spread WE information] help to reduce occupationally induced ill health, the cost of their implementation [5.6 million SEK annually] will in the long run be outweighed by the benefits accruing to society." (Information om arbetsmiljörisker, p. 41)

This statement is not supported (sic!) by any attempt to estimate the actual benefits to society (cf. op. cit., pp. 319-320).

27. A fair amount of such voluntary undertakings are present today. See Information om arbetsmiljörisker.

28. The one who has the information (e.g. a public agency) has that advantage. On the other hand, the preferences of the individual are not known. There is no knowing if superior information on the one side of the problem will more than make up for the loss on the other side.

29. It may be that agents are in some cases not only ignorant, but also ignorant about being ignorant. Would this imply that public activities are called for? In principle this would not be necessary, since the latter ignorance may again be corrected by entrepreneurial activity. However, the information market will probably be less efficient in this case.

30. About a possible flaw in this argument for public intervention, see n. 23.

31. Non-excludability makes it impossible to actually charge for the information as such. For the same reasons discussions on marginal cost pricing and deviations from it is of little practical interest in this context. Note that since these activities are financed by distortionary taxation "... there is no presumption that optimal pricing within the state enterprise will entail marginal cost

pricing." (Atkinson and Stiglitz, 1980, p. 458.)

32. "Statliga anslag till forskning och utveckling 1984/85."

33. We include only major public undertakings. For a more comprehensive survey, see Arbetsmiljöinformation - påverkan, behov och utbud, pp. 139-152, and Information om arbetsmiljörisker.

34. Statliga anslag till forskning och utveckling 1984/85.

The Swedish National Board for Technical Development (Styrelsen för teknisk utveckling, STU) gives extensive support to research and development in private companies. Part of this has usually gone to the WE area. (10 million SEK in 1983/84, "Statliga anslag till forskning och utveckling 1983/84.") However I would hesitate to call this specific support to WE research. It looks rather like an example of the fact that the WE will get a share of general research funding.

The same could probably be said about the clinics for occupational medicine in the country. Primarily, they engage in preventive activities, but they are also important as information centres and research units. It has been estimated that in 1979 the cost for these activities was in the magnitude of 40 million SEK (Jönsson and Lyttkens, 1981). (We should note that the largest group of medical personnel directly engaged in WE related work are those employed in the health service of companies (företagshälsovården). However, this is not a public undertaking.)

35. Miljöstatistisk årsbok 1978. Arbetsmiljön.

36. Of which it receives 83.5%, the rest going to the ASS and the YI (Gullberg, Rundqvist and Starland, 1983, p. 319).

37. Utbvggnad av yrkesmedicinen.

38. The roles of the ASS and the YI in the enforcement of the WE regulations were dealt with in Chapter 3.

39. AML 3rd ch. 3rd section.

40. For example, as argued by McFetridge (1977, pp. 16-23), if regulations decrease research by making such investments more risky, this is not a strong argument for publicly provided research, as apart from partial or wholesale subsidizing. Mainly, for the former to be preferable one would have to show either that returns to research projects are totally independent, or that the state is better equipped than the market to deal with moral hazard problems.

41. This is not to say that these are the only theoretical possibilities. For example, extended patent rights may be used. Or prizes may be awarded to successful inventors. However, these possibilities appear only to a limited extent applicable to WE research types (1) and (3). Patents for basic information are not viable, nor are ex ante determined prizes. The latter is also difficult to envisage for type (3) research. Prolonged patents for type (3) inventions or company research generally are possible (and implies oversupplying of such private research). Ex post determined prizes may look attractive, but this option raises a number of practical problems (cf. Wright, 1983, p. 703). We will not discuss these policy options. (Obviously, the implications of the policy

actually chosen that we derive are relevant also in relation to the patent policy option.)

It has also been shown that direct contracting for specific amounts of research may often be a preferable alternative generally, even without allowing for the possible advantage of avoiding wasteful parallel research (op. cit.).

42. We should also mention here the Swedish Center for Working Life (Arbetslivscetrum). This is an institute for studies on industrial democracy. It is mainly financed from the ASF.

43. In addition, a lump sum goes to the ASS.

44. For the activities of the ASF, see Projektkatalog 1983/84 and Vår verksamhet 1983/84.

45. We should note that by subsidizing the production of WE improving equipment, one will raise WE quality, ceteris paribus. However in view of the effect on long run technological change (see below), the total effect of such subsidies may not be to increase WE quality.

46. Both Annerstedt (1972, pp. 110-11), and Stevrin (1978, p. 254) exemplify the presence of such tendencies in Swedish oriented research.

47. For example, there is free depreciation of such expenditure in companies.

See also n. 34.

48. See, e.g., Annerstedt (1972), p. 17, and Stevrin (1978), pp. 168-77.

49. See, e.g., Odén (1973), and Stevrin (1978).

50. He notes also that coordination has often been advocated without any clear motivation as to why it should be desirable.

51. At the same time, the division of research into fields of priority may make it imperative to improve the planning of research efforts on the level above. Cf. Annerstedt (1972), p. 94-95, and Stevrin (1978), p. 168.

52. Stevrin (1978, p. 255) also notes that in Swedish oriented research there is usually no appraisal of the long run effects of research efforts. Specifically, it may be noted that there are no attempts to calculate social rates of return. Cf. below.

53. Budget maximizing can be seen as just one example of conflicting interest of the bureaucrat/agent from that of his employer. The existence of other conflicting goals of the bureaucrat can also produce this result. It is sufficient in a model of a utility maximizing bureaucrat that net social benefits eventually decrease as the fulfilment of these conflicting goals is increased. (See Mueller, 1979, pp. 164-165.)

54. Jonsson (1985, p. 10) argues that it is unsuitable for research organizations because of the "uniqueness" of their output.

55. Cf. Chapter 3, p. 90. In addition, the board of the ASF also contains two representatives for the staff of the ASF itself. However these may be disregarded in the present context, as they only have a right to vote on internal matters. Similar considerations apply with respect to the board of the ASS (cf. Chapter 3, n. 10).

56. This excludes the question of the general relationship between the amount of publicly funded research and the amount of private research. For recent contributions to this issue (with mutually opposing results), see Levy and Terleckyj (1983) and Lichtenberg (1984).

Cf. also the discussion in McFetridge (1977, pp. 65-71) on responses to subsidization.

57. We note this because the general case for public intervention is much less clear than for research. As noted already in the beginning of this chapter, public support to WE research may also have distributional implications.

58. Although the case may conceivably be reversed in small companies with trade union backing of the employees.

59. However it still makes sense to treat this as different from the production of "new" knowledge. The problems and policy options are different in this case. Also, this kind of information production falls outside the conventional definition of research (see Annerstedt (1972), p. 191).

60. Even with correct risk valuation on the part of the central agency, the present system could lead to more risk-taking on the average. It all depends on how the many information units would be distributed around the correct value; that is, whether the pessimists would be more numerous than the optimists, and whether the pessimists are more pessimistic than the optimists are optimistic.

61. The public undertakings in these areas are financed through general tax revenue and through (uniform) payroll taxes. This system favours those who benefit highly from the publicly provided and spread information. The benefit is being bestowed by those who pay the taxes but are not among those favoured.

Much of what has been said in previous chapters about shifting of payroll taxes and the situation of employees is applicable. There is no need to reiterate it here.

62. For a broad survey, see "Statliga anslag till forskning och utveckling 1984/85."

Neither have we directly discussed the allocation of resources between WE research and information, and other policy areas where collective funding is warranted. This should not be taken to indicate that this is unimportant - only that it falls outside the scope of this study. (See, e.g., Annerstedt (1972), p. 24, for arguments on the importance of this.)

63. Projektkatalog 1983/84, Arbetarskyddsfonden.

5 WORK ENVIRONMENT INFLUENCE FROM OTHER POLICY AREAS

We have now studied the effects of several policy measures that are closely connected with the WE in the minds of many people. However, there are numerous policy measures that are never "thought of" as WE politics that also affect the WE decisions of employers and employees. In this chapter we will analyze the WE influence of some of these measures.

There are (at least) three reasons for this exercise. First, the effects are in all probability far from negligible. When discussing the effects of the WE policy in earlier chapters, it was implicitly assumed that these other factors would remain unchanged. In reality this is not the case. For example, the tax system is independently undergoing changes all the time, and this will influence decisions on the WE. As argued in Chapter 1, any attempt to measure the impact of the WE policy measures discussed above would therefore have to take these intervening measures into consideration. The same is true if we want to understand the development over time of the WE, or the demand for improvements in WE quality. Secondly, in many instances it is probably not realized that decisions in other areas influence the outcome as regards the WE. We hope that the present analysis will be instructive in this respect. Thirdly, the policy measures discussed here interact with the WE policy proper.

It should be emphasized that the measures chosen for the analysis in this chapter only are examples from a larger group.¹ We have picked some that are likely to have a major impact on the WE. First and foremost, there is the Swedish tax system to be considered. The level and distribution of taxes must obviously have a major impact on company decisions, and consequently on the WE. This is discussed in section 5.1. The main effects are to increase WE quality and to discriminate against high-risk industries.

In sections 5.2-5.3, a study will be made of government subsidies to economic activities, and government induced restrictions on competition in product markets. Various subsidies are available for different activities. These can be motivated by regional

considerations, by concern for the unemployment situation, etc. We then turn to the market situation facing different industries. In those instances where prices can be manipulated due to the (public policy induced) existence of trade barriers, monopolies, oligopolies, etc., the cost of a higher level of WE quality can be more easily shifted to consumers.

Finally, in section 5.4 we will discuss the Swedish legislation concerning labour market negotiations. The position of a few well-established unions is greatly strengthened by Swedish legislation. This will tend to raise the quality of the WE, particularly with regard to the public good aspects of the WE. This is also a convenient place to discuss some of the features of the bargaining process, and their possible impact on the WE. There are a number of reasons why negotiations may tend to concentrate on non-WE issues.

The main results are summarized in section 5.5.

Among the intervening factors not discussed in this chapter, there is one group that deserves particular attention. There are a large number of government activities that affect the Swedish WE in the aggregate sense through their influence on resource allocation. For example, the value added tax is not "neutral" in the sense that all goods and services (excepting leisure) would be equally taxed.² On the contrary, there are numerous examples of exemptions and lowered tax rates. In addition, some goods are subject to supplementary taxation. Conversely, the consumption of certain commodities is subsidized, implying lower indirect tax rates or negative taxation (for instance, sometimes housing rents). Furthermore, some services are taxed and some are not, sometimes for reasons that are somewhat obscure (Söderström, 1982). This obviously favours the production of the lesser taxed items. Accordingly, the WE characteristics that are typical for these activities will tend to become more prominent in society. Consequently, the Swedish WE at the aggregate level will be partly determined in this way. If, for example, a line of production that entails many work injuries is favoured by the system of taxes and subsidies, this will, ceteris paribus, increase the number of work injuries in Sweden.

For the most part we will not discuss any of these effects in relation to the policy measures selected for treatment. After all, the purpose of the present chapter is illustrative. The exception is the general "discriminatory" influence of income and payroll taxes (see section 5.1), which are important in relation to the allocative effects of the Social Insurance system.

5.1 The Swedish Tax System and the Work Environment

The tax system exerts numerous influences on resource allocation, a number of which are important in relation to the WE.⁴ Two of these influences have been chosen for the purpose of our analysis: the effect of marginal tax rates on the distribution of company payments for the benefit of employees and on the resource allocation between industries and firms.

The main conclusions from the analysis below are that the tax system increase WE quality in individual firms, and that it discriminates against high-risk (or other low quality WE) industries.

It is essential to realize that this omits important influences of the tax system on the WE. For example, the provisions with respect to depreciation influence investments - when they should be made and in which areas. The favourable treatment of machine investments⁵ is a major determinant of the basic features of the WE. We noted in Chapter 2 that liability claims are tax deductible for a company. This raises the same allocative implication as in the financing of the Social Insurance system - i.e. a bias in favour of high-risk industries and firms. Another example is that changes in average taxation will affect the demand for WE improvements, since it is reasonable to assume a positive income or wealth elasticity of demand.⁶

There is a wide gap between what the individual can buy for his/her wage net of taxes, and what s/he costs the employer. I. Hansson (1983) estimated that the average marginal increase in benefits attributable to a wage increase net of all taxes was approximately 26% of the increase in wage cost to the employer in 1982. This calculation takes account of changes in income transfers, indirect taxation, and views part of the payroll tax (see below) as payment for real benefits.

The uniform payroll tax - currently 36%⁷ - and the progressive income tax are the two main sources of the discrepancy between individual net income and the wage cost to the employer. The payroll tax consists of payments to different pension schemes, to the Health Insurance, to the Work Injury Insurance, and some other minor items. The average marginal tax rate in the personal income tax was 56% in 1982 (I. Hansson, 1983).

An employer in a position to increase payments for the benefit of the employees has three options: to increase wages, to increase non-wage benefits that are identifiable as benefits, and to increase non-wage benefits that are not identifiable as benefits.

An increase in wages will be affected by both the payroll tax and the personal income tax, so that the average employee receives only about 30% of the increase in the wage costs of the company in the form of direct pecuniary benefits.⁸

Non-wage benefits that are identifiable as benefits can take on a variety of forms. There are both benefits not included in our analysis such as private pension plans, and benefits that are among the WE characteristics discussed here, such as the free-of-charge use of sporting facilities, improved office facilities, interior decorations, etc. Many of the latter are not yet part of the tax base for the personal income and payroll taxes. However, the general tendency is to include more of them in the taxable income.

What I have in mind for the final category is principally those "benefits" that follow from decisions on production, marketing, etc. They cannot be separated from those decisions, and cannot be included in the tax base for the taxes in question. The prime example here is the higher levels of workplace safety and health that results from investments in new buildings, new machinery, and/or new technology.

As a result of this system, one would expect that, in the long run, there would be a tendency to provide more of the lesser taxed benefits than in a situation where all benefits were subject to the same degree of taxation, or where marginal tax rates were lower.⁹ As pointed out by Eriksen and Qvigstad (1978) and Ståhl (1972), this will tend to increase the provision of WE improvements. This follows from the expectation that the marginal utility derived by the employee from the last unit of employer expenditure for his/her benefit should, in the long run, be equalized for different kinds of expenditure (cf. section 1.3).¹⁰ Otherwise, the company could buy the same benefits for its employees at a lesser cost, thereby increasing profits. (Conversely, if we take employer expenditure on the benefits of an employee as given, the distribution of taxes implies a welfare loss for employees compared to a situation where all benefits are taxed equally.)

We also expect that any measure that entails higher marginal tax rates, or otherwise increases the gap between company expenditure and net employee income, will raise WE quality, ceteris paribus.¹¹ For example, this holds for the financing of the Social Insurance system, of the ASF, and of the WE loans.

High marginal tax rates will induce also another form of higher levels of WE quality. The argument to follow hinges on the assumption that employees will be compensated, ceteris paribus, for a WE that contains relatively numerous negatively valued characteristics. This compensation is usually thought of in terms of wage differentials, but in principle it can equally well take one of the other two forms discussed above. For the employee, the relevant compensation is the net increase in benefits. High marginal tax rates raise the cost of compensation paid in taxable form. In addition, the progressivity of the income tax, will make each additional unit of such compensation increasingly costly. Both these effects will increase the relative profitability of WE investments.

We now turn to the second effect of the tax system. We argued that high marginal tax rates and progressivity change the distribution of company expenditures. At the same time, compensation becomes increasingly expensive. In this sense, the tax system discriminates against activities where negatively valued WE characteristics are jointly produced (inherently risky activities, etc.). There will therefore be a tendency for resources to be shifted to industries where technology reduces the need for compensation, as compared to the situation where the WE-induced compensation is less progressively taxed, taxed at lower marginal rates, or not taxed at all. This counteracts the allocative effects of the financing of the HI and the WII discussed in Chapter 2.

In a time perspective, one realizes that the increase in marginal taxation that has occurred in Sweden during the last decades (see Table 3.2, p. 107) has presumably raised the quality of the WE, and discriminated against high-risk activities.

5.2 Government Support to Economic Activities

There has been a wide variety of government support to different industries in Sweden during the last decade.¹² For our purpose it is useful to distinguish between support given to alleviate the effects of structural problems, and support given for other reasons to companies in particular industries or regions.¹³ It is with the first of these categories that we will be concerned here. This produces an interesting general tendency for the development of the WE, whereas the other kinds of support mainly affect the WE in the aggregate through their impact on resource allocation (as in the case of VAT described above).

There have been a number of instances where support has been given to specific industries or individual companies, in order to alleviate the negative effects of restructuring the Swedish economy.¹⁴ The main object in these cases has usually been to avoid unemployment - generally or in a particular region or municipality.

This has a bearing on the WE complex for two reasons. On the one hand, investments in new capital - buildings and machinery - are often a prerequisite for increasing WE quality. When new investments are carried out it becomes possible to take account of the WE in a way that was prohibitively costly (if indeed possible) with the old capital stock. By providing support that slows down the process of transformation, we are potentially delaying an increase in the quality of the WE. Moreover the old installations that remain in use are typically those that have a low quality WE. This counteracts the acceleration of this process that follows from WE regulations, outlined in Chapter 3.

On the other hand, the introduction of new technology may lead to new problems in the WE. The slower this process, the more time one has to discover and deal with the problems. The seriousness of this effect depends on the actual WE policy. The relevant aspects of this policy are the degree to which those who introduce the new technology are also made responsible for possible adverse effects, and the way in which research and information efforts (by both the innovators and other agents) are directed. The WE policy pursued in Sweden, where little direct responsibility is placed on the individual producer (see

Chapters 2 and 3), increases the value of slowing down the process of change.

5.3 Markets with Less than Full Competition

In this section, we will deal with markets that are characterized by less than full competition as a result of government intervention.¹⁵ Hence our basic assumption of fixed product prices is relaxed. In section 3.6, the implications of variable product prices for the effects of regulations were discussed. Here some additional issues will be considered. The analysis in this section is applicable inter alia to the public sector. We will discuss markets that are protected from international competition due to trade barriers, markets where competition is curtailed through regulation, and markets where production is the monopoly of a public agency.

A number of industries in Sweden are protected by trade barriers. Apart from employment considerations, the main reason is the need to guarantee a supply of certain commodities, such as clothing and foodstuff, in case of international crises.

Ostensibly, then, the effect of these barriers to trade is to enable Swedish producers to retain a higher level of production than would have been possible in their absence. At the same time, firms in the protected industries might have increased opportunities to manipulate the prices of their products. Thus, it might be possible to shift (part of) an increase in production costs to consumers. Risa (1982) has suggested that the political and unionized pressure for better WE as a consequence of this protection will lead to better WE, ceteris paribus, in protected industries. The reason being that the "resistance" to cost-increasing measures, such as increasing WE quality, would be less marked in these industries. Empirical support is also presented for the existence of an effect of this kind in Norway. A "totally competitive" industry is associated with a severity rate¹⁶ that is 2.33 higher than for a "totally sheltered" industry, in the period 1960-70. (The average severity rate for the Norwegian economy as a whole is less than 2.33 for that period).

Introducing a trade barrier may cause an existing demand for WE improvements to be fulfilled. Existing trade barriers may at the same time facilitate accomodation to changes in demand. An upward shift in the demand for positive (less negative) WE characteristics can result from changes in taste, rising real incomes, more accurate information, etc. (cf. pp. 106-108). To the extent that trade barriers make price-manipulation possible, and that this provides a less costly way of accomodating to a changed situation, this will lower employer resistance to the regulations and other demands. (This was more extensively discussed in section 3.6)

Other interventions by public agencies that lessen the degree of competition in the market, decrease the number of producers, etc., will produce the same kind of effect as trade barriers. The building industry, the insurance market, and the market for pharmaceuticals, provide possible examples of this effect.

Among the publicly run monopolies two basically different categories can (for our purpose) be distinguished: those that sell their products, and those that are (more or less) tax-financed. Producers in the first category have the same opportunities as described above, only to a greater extent. This is especially true of a number of them that face a very inelastic demand, viz.: the tobacco company, the company for wines and spirits, the telephone company.

In previous chapters, we have been dealing only with firms selling their products on a market. This analysis is not applicable to public agencies producing services. Their budget constraint is of a different nature. Cost-increasing WE regulations might leave wages, etc., unaffected in that case. The "owner" (the tax payers) will then bear the burden. (The same will happen, mutatis mutandis, if publicly owned firms producing for a market are allowed to run tax-financed deficits.)

One would thus expect that the above mentioned tendencies are even more marked for the second category of public agencies. In that case, any increase in costs is shifted, not to the consumer, but to the tax payer. The tax payers are more numerous than the consumers of a particular commodity, so the increase in burden is less noticeable. Secondly, taxes are used to pay for a number of activities. The connection between the cost of any of these and the level of taxes is seldom made clear. Thirdly, the individual lacks direct influence in this case (as a consumer s/he can always choose not to consume). The

only influence is through the political process.¹⁷

So far we have in this section identified a number of tendencies that might lead to higher levels of WE quality, ceteris paribus. We should note, however, that there is also a related countervailing tendency. The policy measures described above may also tend to strengthen the bargaining power of the employer in relation to the employees. To the extent that this in fact happens, it might lower the remuneration of employees (including WE quality), ceteris paribus. Furthermore, if there is a change in preferences for different kinds of compensation, employers' resistance to a costly change in the compensation mix will be stronger.

This kind of effect ought to be most marked if the monopolist also has monopsony power in the labour market. Some of the publicly run monopolies are indeed almost in that situation. For example, the health care services, and part of the universities (particularly the humanities).¹⁸ While there is admittedly an "external" labour market for people engaged in these activities in Sweden, it is small and it is difficult to gain entrance to this market. The smallness can be a result of "market forces" - as for humanists - or a result of government regulation - as for health care personnel.

Monopsonies (or the like) can also exist locally, in areas where there are only a few employers within reasonable distance. Moving to find a new job is costly, both in physical terms and due to the stress involved. It gives the employer an advantage, if there is no alternative employment in the vicinity. The reason for noting this here is that subsidies to companies in sparsely populated regions can create situations of this kind.

5.4 Labour Market Negotiations

Certain groups of employees have in principle individualized negotiations over all working conditions. This is so, for example, for senior staff in the private sector. However, the great majority of employees in Sweden are generally never personally engaged in negotiations with their employer. They are instead represented by

trade union officials. In this section we will be concerned only with these latter groups. The analysis bears out the importance of the fact that the individual employee and his/her preferences are represented by the union.

We begin our analysis with the relationship between the trade union and its members. Collectivization is strengthened by Swedish legislation, and this tends to raise the quality of the WE. In conjunction with this analysis, it is convenient to provide a fuller treatment than hitherto of the bargaining process as such. There are several arguments that support the view that negotiations usually concentrate on other issues than the WE. We also briefly discuss WE regulations as a possible direct strategy of the unions.

We should also note that much of Swedish labour market legislation can be seen as an attempt to strengthen the influence and bargaining position of employees in relation to their employers.¹⁹ This presumably changes the bargaining positions of the parties, and thus possibly the outcome of negotiations. However, this aspect of labour market legislation will not be analyzed here. We focus only on issues that relate to increases in WE quality vis-à-vis other benefits. Furthermore we will concentrate on the position of the trade unions. This is not to deny that similar arguments in many cases could be made for the other side in the negotiations - employers and employers' associations. The point is rather that it is the legislation enacted in favour of trade unions we are dealing with here. (No corresponding legislation exists for employers' associations.)

Legislation Concerning Labour Market Negotiations

Swedish law has conferred upon the major and established trade unions extensive privileges and powers (fewer obligations).²⁰ In practice, the collective agreements between the established unions and the employers determine most aspects of the working conditions for all employees, whether they be members of that union or not. In general, the collective agreement is viewed as a norm, the departure from which necessitates specific agreements between the employer and the employee.²¹ In addition, such departures would normally not be allowed, as they will conflict with the collective agreement. (For example, it is normally not permissible to pay different wages to union members and non-members.) In a number of cases it is the prerogative of the established unions to undertake negotiations with the employer. The law favours these unions in this and other ways.²²

Union membership is widespread in the Swedish labour market. The percentage of unionized labour ranges from close to 100% for blue collar workers in the manufacturing industry to 70% for graduates.²³

For our purpose it is relevant to note that decisions influencing the WE will normally be taken by (representatives of) one of the established trade unions. First, and most importantly, there are the collective agreements on wage levels, wage forms, and working hours. Even when WE issues are not dealt with in these negotiations, the agreements define the upper limit for WE quality. However, we have argued that the total amount of payments that are to the benefit of employees is to a large extent determined by conditions external to the negotiations. In other words, the sum of wage increases, increases in WE quality, and other benefits, is to a certain extent exogenously given. Therefore, decisions on wage levels imply decisions within certain limits on the amount to be spent on the WE.

Secondly, employees can influence the WE through their safety representatives, and through representatives on the joint safety committees. These functions are regulated in the AML. Both these kinds of representatives are normally appointed by unions that have collective agreements with the employer. This is generally one of the established unions.

Thirdly, employees are allowed representatives on the board of certain companies and cooperatives with at least 25 employees, as well as of state authorities.²⁴ These can only be appointed by the established unions.

Fourthly, the right to influence the activity within a company that follows from the 1976 Act on the Joint Regulation of Working Life (Lagen on medbestämmande i arbetslivet, MBL) is to a large extent reserved for the established unions. The act does not give the individual employee any influence whatsoever.

In summary, then, the trade union represents individual employees in negotiations with their employer in a number of ways. Moreover it is practically given a free hand in these negotiations, as long as different employees are treated fairly and in a non-discriminatory manner. Only in a minor number of cases is the union unable to act freely in its dealings on behalf of the employees.

From the above presentation, it follows that we can use the analogy of a government and its constituency in our discussion of the union and employees in relation to the WE. Union representatives are elected. Thereafter their function is to work for the benefit of their members (and to a certain extent non-members). However, in this system one will encounter the same problems as with the political process. Namely, that the representatives and the bureaucracy established to support them cannot be expected to behave as perfect agents on behalf of the constituency. They will have interests of their own, such as a wish to be reelected, that will influence their behaviour. We will return to this question below.

The elected "government" undertakes, among other things, to work for a higher WE quality. This work can be seen as the public provision of public goods, private goods, as well as goods in between these two extremes. The regulation of the temperature or noise level at a workplace comes fairly close to being a pure public good, since it has the two characteristics jointness of supply and non-excludability. Buying a better chair for a typist is at the other end of the spectrum - a clear case of a private good. Finally, there are WE characteristics that fall between these extremes. Either the provision of these goods does not supply everybody with the same amount, and/or an increase in the consumption of one person decreases the consumption of others but by less than the same amount. An example of the former is control of emissions from a machine where those working in the vicinity of the machine benefit most. The latter could be exemplified by the construction of a recreation area where congestion detracts from the utility of using it.

Under the assumption of roughly fixed total payments to the benefits of employees, these goods are paid for primarily through foregone wage-increases. Thus, by trading wage-increases for increasing WE quality, the union "taxes" all employees to finance the provision of these goods.²⁵ It should be noted that free-riding cannot exist in this case.

Decision-making within a trade union may in general be expected to function analogously to any association governed by more or less "democratic" rules. For example, it may be characterized by what is often called "median voter"²⁶ type of effects. Such features would inter alia affect the choice between pecuniary and non-pecuniary benefits (such as WE quality). Exactly how this would influence the WE is difficult to predict, without detailed information on the distribution of incomes, wage increases, and WE benefits, within a union. But we certainly should expect the above mentioned choice to be subject to such tendencies.

The increase in bargaining strength apart, the rationale for public (union) provision of private goods is the greater administrative efficiency in collective vs. individual bargaining, increasing returns to scale in gathering the necessary information on health risks, etc., and the fact that information is a public good which would otherwise be underprovided (cf. Chapter 4). We should also note that there might be distributional goals. These positive effects must then outweigh the inefficiency introduced by the public provision of private goods. This arises in so far as it is not possible to take the wishes and specific circumstances of each individual into account.²⁷

To identify the optimal provision of WE characteristics by the union, and to contrast it with the actual provision, is under the prevailing circumstances an interesting but extremely complex task. We will not make any attempt in that direction. Let us just give one example of the problems involved. WE characteristics are in essence most closely related to the concept of local public goods. We have in fact a large number of communities (firms), each with its own chosen set of publicly provided public and private goods. However, there is certainly not free mobility between communities, since moving to another community is costly and sometimes requires that somebody else has to leave in order to make room for you. (In some cases mobility may be so low as to make the analogy with a general public good more applicable.) If we add to this the fact that we are dealing with a wide spectrum of commodities to be provided, plus some other features of the real world,²⁸ and we have moved beyond the scope of economic analysis, at the present state of the science.

The effects described here generally work in the direction of raising the quality of the WE. The fact that employees appear as a collective strengthens their bargaining position (which should provide higher total benefits, and thus a better WE), enables them to deal with public goods in the WE including the gathering of information, and also enables them to take account of merit wants (if such exist).²⁹ As noted at the beginning of the section, this collectivization is very much furthered by public policy.

The Bargaining Process

The focus will now turn to some of the properties of the bargaining process where elected employees' representatives negotiate with employers. There is little reason to assume that negotiations between the associations of employers and of employees lead to an optimal balance between increasing pecuniary benefits and WE quality (Eriksen and Qvigstad, 1978; Ståhl, 1972). Ståhl suggests that there is a tendency to concentrate on pecuniary benefits in the negotiations,³⁰ and that improvements in WE quality may tend to be undersupplied relative to wage increases. In terms of our model, this implies that one unit of company expenditure on pecuniary benefits gives the employees less utility than if it was spent to raise the quality of the WE.

The very nature of higher levels of WE quality qua employment benefits makes it likely that they will be avoided in the negotiations. While we may be perfectly willing to risk our own life and health in return for all sorts of benefits, many people find it unpleasant to explicitly bargain with the life and health of other people.³¹ (For example, in situations with a high perceived risk of being faced with personal responsibility for causing death and illness.)

However, there may also be highly "rational" reasons for concentrating on pecuniary benefits. As noted above, it is usually not possible to take account of the situation of every employee individually in collectivized negotiations. This centralization therefore implies the uniform distribution of the benefits gained (at least within subgroups). This being the case, it would not be surprising if certain WE characteristics that fall close to the private good side of the spectrum are left out of the negotiations.³²

A second reason for choosing to concentrate on pecuniary benefits is that they are relatively easy to scrutinize. It is not too difficult to check that you have received what you agreed upon. All interested employees can easily be informed as to what they should receive in terms of benefits, since it is a one-dimensional measure, and there is relatively little need for special controlling actions to ensure that everybody receives their due. To the extent that control is necessary it is also facilitated by concentration on one item. In contrast, the

WE is multi-dimensional, and the different dimensions vary in relation to the ease of enforcement of agreements on quality, etc. While some, in principle at least, are easily controlled, factors influencing the health of employees represent the other extreme and one usually needs specific equipment and technologically skilled personnel to ensure compliance. The fact that such controls are costly, even for more readily checked items, will lead to relatively more of easily controllable benefits in general and pecuniary benefits in particular.

It seems reasonable to assume that there are increasing returns to scale in the control of WE quality. This follows from the advantages of specialization and the need of (sometimes expensive) equipment. For this reason, collectivization should decrease the concentration on pecuniary benefits.

There is yet another aspect of collectivized bargaining that should be noted here. One can envisage circumstances where two or more trade unions compete over a given amount of resources for wage increases, etc. One way of obtaining a large share would be to exaggerate the amount of negatively valued characteristics present in the WE of the members (and *vice versa* for positively valued ones).³³ If there are WE investments that benefit all employees, these may also be more easily agreed upon than the distribution of pecuniary benefits. WE quality would then serve as a common and unifying goal (and could therefore also give increased bargaining power). (Conversely, employers may have agreed upon a maximum level for wage increases. One way to circumvent this agreement could be to raise WE quality instead.)

Regulations as a Trade Union Strategy

We know from Chapter 3 that many increases in WE quality come about as a result of WE regulations. As was shown there, given plausible assumptions, this is a superior alternative for employees in relation to purely relying on labour market negotiations. This argument was partly based on "market imperfections" in the labour market. However, we also argued that the very nature of regulated increases in WE quality could be to the advantage of employees. In addition there is the fact that the costs of control are largely carried by the YI. An appealing strategy for a union could therefore be to restrict the negotiations with the employer(s) to wages and related benefits, and to leave questions of the WE to the legislators.³⁴ This would also free them from having to bargain with life and health. This is primarily relevant for those employed in dangerous industries/firms.

(In this case, they might be joined by employers, because of the subsidy entailed in public financing of the control apparatus, and of the "unpleasantness" inherent in WE bargaining.)

It is important to note that this is only relevant if the labour market negotiations would otherwise have included WE issues. As should be obvious by now, this is far from certain. If this would have been the case, the aforementioned strategic possibilities exist mainly because WE regulations are an integral part of Swedish WE policy. In other words, the mere existence of a regulatory policy produces this result.

It may also be in the interest of the union bureaucracy to have WE questions placed in the hand of legislators. Thus the only conceivable channel for employee influence on the major WE decisions is through centralized unions. WE questions then provide part of the raison d'être for groups of union officials.

Will regulation come about? In Chapter 3, some arguments were presented as to why those engaged in the public WE apparatus would be in favour of increasing WE quality. One possibility is therefore to await the enactment of new regulations in due course.³⁵ The other possibility is to actively seek to get them enacted.

Like any other interest group, unions can influence parliament to make decisions in their favour. Generally politicians try not only to "maximize social welfare" but also have objectives of their own, such as staying in power.³⁶ Interest groups can influence politicians not only through public opinion, by "making a nuisance of themselves", etc., but there is also scope for explicit and implicit "trading" between interest groups and politicians. Landes and Posner (1975), for example, have suggested that this could also take place in the field of legislation. "In the economists' version of the interest-group theory of government, legislation is supplied to groups or coalitions that outbid rival seekers of favorable legislation. The price that the winning group bids is determined both by the value of legislative protection to the group's members and the group's ability to overcome the free-rider problems that plague coalitions. Payment takes the form of campaign contributions, votes, implicit promises of future favors, and sometimes outright bribes. In short, legislation is 'sold' by the legislature and 'bought' by the beneficiaries of the legislation."

(Op. cit., p. 877.) It does not seem unreasonable to assume that effects of this kind exist in the formation of Swedish labour market legislation such as that governing the WE. For example, there is generally a close relationship between (most of) the trade unions and the Social Democratic Party (in power 1932-76, 1982-), the campaign contributions from unions to this party, and the fact that many unions collectively enlist their members as party members. Moberg et al. (1982, pp. 154-55) view Swedish labour market legislation during the last 30 years partly as a joint strategy from the unions and the Social Democratic Party. Nordfors (1985) also discusses the close cooperation between unions and party. He argues that in the discussions before the enactment of the AML, the policy of the Social Democratic Party was largely to let the confederation of (the blue collar) unions decide whether new legislation was called for (op. cit., pp. 53-55, 83, 154). (However it was a non-socialist government that actually enacted the AML.) At the same time, employers will of course try to use their political influence to hinder any costly legislation.

It is conceivable that the mere existence of this strategy (to refer WE decisions to the legislature) would alter the bargaining position of the parties. In that case, it may be possible for the unions to obtain higher benefits, or part of them, without evoking the legislative process, if they have the greater political influence. However, this presupposes that these benefits are not paid for in the next round of negotiations.

5.5 Concluding Remarks

In this chapter, we have identified a number of public policy influences on the WE. We have seen that tax policy have tended to raise WE quality in individual firms. This follows since a) WE investments are an important group among the lesser taxed methods of increasing employee utility, and b) because it becomes expensive to compensate for negatively valued WE characteristics.

For the latter reason, the tax system also generally discriminates against activities that produce negative WE characteristics jointly with other outputs (are "inherently" dangerous, etc.), and therefore creates a need to compensate the employees.

In the last section above, we argued that the legal reinforcement of collectivization on the part of employees would influence the WE. It has implications for the provision of public and private WE goods. The strengthening of their bargaining position will tend to raise all benefits, including a higher WE quality. It will also increase the supply of WE characteristics that are in the nature of public goods. At the same time, there is an efficiency loss in so far as this entails uniform provision of non-public goods. We noted also that collective action on the part of employees is cheaper administratively than individual negotiations, and will lead to decisions based on more accurate information of a general kind.

We then discussed some of the properties of the bargaining process. For a number of reasons, increases in WE quality may tend to be relatively undersupplied. The influence of labour market legislation on these tendencies is not unambiguous.

We also touched upon some policy areas that exert a less direct influence on the WE. Subsidies aimed at delaying the structural transformation will also delay increases in WE quality. On the other hand, precisely these delays can decrease the risk of severe mistakes in the field of occupational safety and health.

Another rather indirect influence is the decreased resistance to cost-increasing WE investments that presumably follows from market conditions characterized by less than full competition. The outcome of labour market negotiations is also influenced by policies that create monopsonies in segments or local parts of the labour market.

Notes to Chapter 5

1. It is possible to find any number of measures that on reflection are seen to affect the WE (though often the impact may be small). To exemplify: in the determination of the rules for slaughter-houses there are conflicting interests between the concern for public health and workers' safety and health; building regulations partly determine

what kind of tasks will be performed by builders; parliament decisions on reports to be given in school are important for the WE of teachers.

2. See, e.g., Brundell (1983), Mattson and Bergkvist (1983), and Söderström (1982).

3. One could note, for example, that the consumption of certain foodstuffs, including meat, was recently subsidized, and slaughtering is the activity where occupational injuries are most common in Sweden.

It is easy to find other examples. One particularly obvious one is the government support accorded to firms for a variety of reasons, see section 5.2.

4. It is also important for psycho-social characteristics. For example, high marginal tax rates decrease the appeal of an effective but tiresome wage-form.

5. Cf. Chapter 3 pp. 135 and 140, and n. 109, and references given therein.

6. See Viscusi (1979a), pp. 13-14 and 238-239, for this demand characteristic. (But see also the slightly different result in Thaler and Rosen (1975), p. 278.)

With respect to disposable income, one must distinguish between increases in the compensating wage differential and other kinds of income as pointed out by Henderson (undated). A change in the WE-compensating part of the wage entails both an income and a substitution effect. For instance, an increase will make it more costly to demand higher WE quality, ceteris paribus, since the compensation foregone is greater (substitution effect), while at the same time the increase in income tends to increase demand (income effect).

There is another way in which the tax system may change the WE that is worth noting, though not even qualitative conclusions can be drawn as to the ensuing direction of the influence. WE decisions can be treated as a portfolio choice for the risk-averse individual. We apply the portfolio choice model as presented in Atkinson and Stiglitz (1980, pp. 97-127). The discussion below is based on their presentation and results. (The analysis on this point is far from exhaustive, but provide some additional insights.)

There are two assets - one risky and one safe. The individual's choice of allocating resources between these two assets will be influenced by wealth and income taxation.

Ex ante compensation such as the wage in this context is a risky asset - the yield depending on the state of the world. To this category belong also positively valued WE characteristics, which require that you are at work if you are to benefit from them. Ex post compensation (insurance) is a safe asset. In addition, WE investments to reduce occupational hazards can be viewed as a safe asset. If you remain uninjured and healthy the risky asset yields more than the safe; otherwise the opposite happens. (Obviously this characterization greatly simplifies the problem.)

The wealth tax will normally decrease investments in the risky asset. For income taxation (the tax assumed to be proportional) we must distinguish between two kinds of risky asset: the wage, where losses are fully offset against tax, and increases in WE quality where there is no loss offset. If the risky asset is the wage, more will normally be invested in this when there is income taxation. (Thus social risk-taking is increased. However, this is not the case for private risk-taking.) When the risky asset takes the form of higher levels of WE quality (that you enjoy when at work), it is less likely than for the wage that the proportion invested in this asset increases (the effect may even be reversed).

It follows that the effects are not very clear-cut, when there is both wealth and income taxation. They are even less so when there is more than one risky asset to choose from, as is generally the case.

7. In addition, under the collective agreements between employers and employees, the former pays a payroll fee between 6% (blue collar workers) and 10% (white collar workers).

8. A person with a yearly income of 60,000 SEK would receive 30%; one with a yearly income of 90,000 SEK would receive 19%. By concentrating on the direct pecuniary benefits, we abstract from a number of effects included by I. Hansson (1983) in his calculations.

9. In a different framework, Viscusi (1979a, pp. 14-16) shows that for a given wage schedule, a payroll tax will cause workers to demand a safer WE, if wealth effects can be ignored. The wealth effect of the tax operates in the opposite direction. (Cf. also n. 6.)

10. Incidentally, since the marginal tax rate increases with income this partly explains why the WE is better for persons with higher income, as noted by Eriksen and Qvigstad (1978) and Ståhl (1972). This observation is often confused with the compensating wage differentials issue. A complementary explanation is of course that the demand for higher WE quality presumably rises with income (cf. p. 193 and n. 6).

See also n. 32.

11. See Appendix 1 for proof.

12. See Lundgren and Ståhl (1981).

We will not discuss those general subsidies that are primarily part of stabilization policy (such as the so called investment funds).

13. As pointed out by Lundgren and Ståhl (1981, pp. 20-21 and 75), it is often only ex post that it is possible to determine in which category we should place the support given.

14. See Lundgren and Ståhl (1981).

15. Naturally, this is a relative concept - the market characterized by full competition is a theoretical construct. In this section, we will discuss markets that are so far removed from this "ideal", that they are more properly approximated by concepts such as monopoly, oligopoly, etc.

We will not discuss the effect of market structure on the research and development conducted by firms. See Braunstein, Baumol and Mansfield (1980, pp. 22-25) for a discussion of this.

16. See section 1.1 for an explanation of this concept.

17. This is not to say that there would be no employer resistance to WE investments. Cf. Lundberg (1982), p. 45.

18. For these two categories the bargaining position of the labour force is additionally weakened because collective action in the form of strikes either has no effect (humanists) or has too much effect (doctors and other health care personnel).

19. For example, the Act on the Joint Regulation of Working Life (Lagen om medbestämmande i arbetslivet, MBL) and the Security of Employment Act (Lagen om anställningsskydd, LAS).

20. The characterization of the legal status of unions vs. their members and other employees follows Hemström (1981), where a more detailed presentation can be found.

21. Hemström (1981), p. 27. As another example of the powers conferred on the established unions we quote from Hemström: "... otherwise mandatory legislation in the areas of social security and labour law very often allows exceptions to be made through collective agreements entered into or accepted by national labour organizations. And ordinarily such exceptions may also be applied to non-members ..." (Hemström, p. 176).

22. Hemström (1981) argues that as a natural consequence of the power thus conferred upon the established unions, they also should have responsibilities for all employees. In some cases they should be under the obligation to give equal treatment to members and non-members.

23. Hemström (1981), p. 75.

It is likely that this can partly be explained by social factors.

However, another contributing factor is probably that the unemployment insurance provided by the union is heavily subsidized. Members' fees only contribute about 10% of the finance - the rest is paid by taxes (Söderström, 1983, p. 69). Though a union membership is not a prerequisite for admission to the insurance, it may well be thought to be by many employees (Hemström, 1981, p. 37).

In these circumstances, membership fees are not large enough to lead to serious free rider problems. Membership fees were 1977 in the magnitude of 1% of the yearly wage (Hemström, 1981, p. 76). The net expenditure is probably smaller today, because membership fees since 1983 provide tax reductions.

However, union membership is normally less widespread in smaller companies (Persson, 1979, ch. 9). This may create problems in relation to the central position accorded to the established unions. For example, non-unionized labour may have less access to WE information (Information om arbetsmiljörisker, p. 171).

24. The Act on Board Representation for Employees in Joint Stock Companies and Cooperative Societies (Lagen om styrelserepresentation för de anställda i aktiebolag och ekonomiska föreningar), and the Decree on Board Representation for Employees in State Authorities (Kungörelsen om styrelserepresentation i statlig myndighets styrelse).

25. Incidentally, if the amount of wage-increases foregone rises with income because the union pursues an income-equalizing policy, then the equalizing effect will probably be reinforced by the provision of higher WE quality. This follows from the expectation that low income earners will face the "worst" WE (see n. 10 and n. 32 for arguments for this), and that this will be improved first.

At the same time, paying by means of foregone wages implies that the "taxation" is regressive, since the wages foregone would have been progressively income taxed. On the other hand, the income equalizing policy would counteract the regressive effect.

26. See, for example, Mueller (1979) for a presentation of this notion.

27. Cf. eg. Atkinson and Stiglitz (1980), pp. 497-500.

28. E.g. individuals are heterogeneous in their preferences; a person who moves to change his/hers employment is at a disadvantage, since newcomers will be fired first, if the need arises; individuals typically are not fully informed about the possibilities offered at all other employments.

29. This assumes that employees are not overcompensated in the way suggested by Veljanovski (1982a). Cf. the discussion on pp. 74-75.

30. Under certain circumstances it might indeed be a preferable strategy for the trade union to concentrate on pecuniary benefits. See Chapter 2, n. 1.

31. Cp. Nichols and Zeckhauser (1977, p. 41): "The unions, smarting under the charges that they were too willing to tolerate health and safety hazards in exchange for higher wages, pushed hard for a tough bill that would defuse the pressure on them to take a harder negotiating line."

32. As noted by Ståhl (1972) this feature may help to account for the fact that high officials with individualized negotiations have better WE than groups of employees that have to rely on collective agreements. It does not follow, however, that workers would necessarily be better off if they also negotiated individually, since the increase in administrative costs might outweigh the benefits.

See also n. 10.

33. Here we could also get median voter kind of tendencies between the different unions. Cf. p. 203.

34. Note that when regulations work as a restriction on competition, this will usually favour those already in the labour market. The unions have no obligations to work for the benefits of would-be employees (members).

This strategy may also be used if the union has equity goals interpreted in terms of equal provision of WE quality between firms and industries.

35. Even when a citizen is in a dangerous situation because of free individual choice, a government may face extensive obligations in saving him/her from the danger. Cf. Appendix 3.

36. See for example Mueller (1979).

6 DISCUSSION OF SWEDISH WORK ENVIRONMENT POLICY

We begin the discussion in this concluding chapter with a brief summary of the main results derived in the preceding chapters. These concern the effects on the physical shaping of the WE of a number of policy measures. We then turn to the issue of policy evaluation. It is beyond the scope of this study to make a final appraisal of WE policy. Nevertheless it is instructive to consider the question of evaluation, even without the pretention of being comprehensive.

Before looking at the effects of the WE policy, it is worth emphasizing again that the WE is influenced by many factors other than "WE policy". Some of these other factors that are also part of government policy were discussed in Chapter 5.

6.1 Brief Summary of the Major Effects of Swedish Work Environment Policy

It would take a long time to repeat here the assumptions upon which the analysis has been based. Obviously, the results below are contingent on the validity of these assumptions. In particular, the reader is referred to the general assumptions and framework presented in sections 1.2-1.3.

In the preceding chapters, we have analyzed the effects of some policy measures that are important for the physical shaping of the WE. These effects were studied in terms of the incentives generated for such decisions. We also discussed how the changes brought about affect the situation of the individuals concerned. Finally, we noted the influence on the "WE in the aggregate"; that is, on resource allocation between sectors of the economy with differing WE characteristics.

We began in Chapter 2 with the Social Insurance system, particularly the Work Injury Insurance (WII). This constitutes a major interference with the labour market contract. We argued that the solution to the "compensation issue", represented by the WII and the Health Insurance (HI), differs on a number of points from what would have resulted without these public policy measures.

Labour market negotiations in combination with the insurance market would lead to a different outcome on at least two points. First, in the construction of the Social Insurance system, there is no relationship between the expenditure to cover insurance payments to employees of the individual firm and the occupational injury and sickness absenteeism record of that particular firm. This implies that less will be spent to prevent injuries and to reduce absenteeism. New technologies will be biased towards solutions that embody relatively more of negatively valued WE characteristics. In the aggregate, we will get a shift of resources to activities and industries where injuries and absenteeism are more common.

Secondly, the insurance coverage of the individual employee is likely to be more comprehensive than in the case of non-interference. This is particularly the case with sickness absenteeism, but probably also for minor occupational injuries. To the extent that employees (or their representatives) underestimate the probability of these events, the public provision of insurances represent an even larger increase in coverage. It is also possible that the increased coverage reduces the prevention activity (with respect to injuries) of employees to some extent.

It is highly probable that the compulsory and almost complete coverage for minor occurrences constitutes a tendency towards over-insurance for large groups, in the sense that they would not voluntarily and personally have paid for it (even with correct information on probabilities).

Next, in Chapter 3 we turned to policy measures directly aimed at the decisions on the WE. We began our analysis with the main instrument of WE policy - The Work Environment Act (AML).

At one extreme, it is possible to argue that this body of law has had no impact on the WE. This follows since the specification and implementation of the law is mainly governed by employers and employees. The ruling bodies (at the ASS and the YI) are composed like arbitration boards. Labour market negotiations could conceivably have produced a quite similar organization. In this case, the only effect noted here is the subsidy implied by the government financing of this system. The subsidy goes to those concerned with the WE characteristics dealt with by the law; chiefly those engaged in activities that have relatively numerous occupational hazards.

However, a rather good case can be made for granting the AML an effect in accordance with its officially declared goal - to increase the quality of the WE. Three assumptions which are together sufficient for this to happen are: 1) the "third party" on the arbitration board supports measures that seek to raise the quality of the WE, 2) increasing WE quality is desired by one of the labour market parties, presumably the trade unions, and, 3) the law and the implementing organization can in practice influence the WE.

This case was then analyzed. Given the first two assumptions above, an effort will be made by the ASS and the YI to increase WE quality. We argued that this is a reasonably likely situation. There would be a subsidy similar to the one mentioned above. Controlling costs would be borne by the public instead of by the parties on the relevant part of the labour market. To varying degrees, this is also true for negotiation costs.

We then identified a number of tendencies that ought to be present, given that the enforcement of the AML would also induce increases in WE quality. The composition of the employment contract would then change. By the second assumption above, employees would gain at the employers' expense. We saw in Chapter 2, that if employees underestimate the risk they face, this will favour high-risk firms and industries. The Social Insurance system had a similar effect. This tendency would be counteracted by the AML. However, with respect to the insurances the effect is only partly neutralized.

We must also consider that the properties of the bargaining process might lead to a concentration on pecuniary and related benefits, as discussed in Chapter 5. This implies a suboptimal employment contract, in the sense that the utility of employees could be increased without any increase in the cost for the company. In that situation, increasing WE quality through "regulation" will be to the benefit of employees and possibly also to that of employers. A similar result would ensue if employees risk perception becomes more accurate as a result of the induced changes in the WE.

Finally, we considered the possibility of giving people higher WE quality than they would individually have favoured. The AML can be used to enforce an increase in WE quality against the wishes of both employers and trade unions. Given the fact that the state provides the whole apparatus surrounding the decision-making boards (as well as the labour inspectors), it is conceivable that this could happen. An important addition is that the reduction of preventive measures caused by the Social Insurance system can be fully counteracted. There may also be "paternalistic" arguments; for example, that employees also underestimate occupational risks when regulations exist. Trade union officials may also be in favour of providing their members with higher WE quality than they would have wished, ex ante.

However, the enforcement procedure of the YI (and the ASS) is an example of negotiated compliance, rather than a penal strategy. We showed that this may often be a preferable strategy, given the institutional setting. In addition, compliance is only partial, and local variations may be allowed. It is then not possible to tell how large are the subsequent increases in WE quality. The conclusion follows that at an aggregated level it is usually impossible to determine with any precision the effects of the increases in WE quality that follows from the WE regulations. All such effects are modified by the nature of the enforcement system.

In the latter part of Chapter 3, we reviewed the Swedish experience with economic incentives. We also briefly discussed the opportunities to use economic incentives in WE policy. (The results from that discussion will be used in the next section.) The Swedish policy measures consisted of two sets of subsidies to WE investments. The effects of these - the WE funds and the subsidized loans - were shown

to be an increase in certain kinds of WE investments. (However one of these - the WE funds - was not necessarily a net subsidy to the company in question.) However, the effect on total WE investments is uncertain, both with respect to individual companies and society as a whole; this is also the case with the welfare of the individual employees concerned.

In order to facilitate the analysis, we assumed in Chapters 2 and 3 that each agent had a socially optimal amount of information; that everything that "ought to be done" by the government in terms of information policy was actually carried out. In Chapter 4, we discussed the policy necessary for this condition to be fulfilled. This included both research policy (information production) and (dissemination of) information policy. In Chapter 4 we also discussed the effects of the forms chosen for this kind of policy in Sweden.

It is rather obvious that research generally warrants public support. Therefore, we limited our discussion to the following issue: should research and information related to the WE receive relatively more support than other kinds?

We concluded that research concerning basic facts about the WE might need some special support. There was no a priori efficiency rationale for other public intervention in this vein.

However, research and information policy is not invariant to other kinds of WE policy. The Social Insurance system lowers the private return to WE research generally, as well as to information gathering. To fully counteract this, it is necessary to give additional public support to practically all kinds of private research. This is so because some WE research must be conducted at "company level", and is indistinguishable from other company research.

Beginning with research, we then turned to the effects of the policy measures actually chosen. We noted first that these consisted of directed private production (public provision) and non-directed public production. We found no efficiency rationale for the support accorded to "compliance technology" and "enforcement technology". Since the support to research is channeled through public bureaucracies, the tendencies usually associated with such organizations might be

present. Finally, the user influence will tend to increase the volume of research, at least the part that is financed from general tax revenue. It will also lead to a concentration on those areas where the private rate of return is highest. In other words, the tendency to increase the total volume of WE research will be less marked for any given expenditure.

Information spreading is encouraged in two ways. It is a public undertaking, and employers are ordered to keep their employees "well-informed". These policy measures will improve both labour market parties' knowledge of general WE information and of each other. The public undertaking involve public bureaucracies with strong user influence. We therefore expect tendencies similar to those discussed for research policy, mutatis mutandis.

As far as financing is concerned, we noted that those who utilise the information produced and disseminated will benefit (receive a subsidy). This is paid for either by the tax payer in general (non-specified tax revenue financing) or by wage earners (payroll tax financing).

It is eminently obvious that not only those policy measures that are "thought of" as WE politics influence the decisions on the WE. Therefore all conclusions regarding the effects of WE policy derived above are strictly on a ceteris paribus basis. They concern the relative determination - as opposed to absolute - of WE characteristics. If we want to discern the absolute effects of government policy on the WE, then non-WE policy must also be taken into account. There are both stable and changing factors in that category. The stable ones are important in the determination of the WE, but they can be left out if we only study changes brought about in the WE. However, the changing factors must always be taken into account when we discuss the effects on the absolute level of WE characteristics.

We do not propose to make any comprehensive study in this direction. However, we did exemplify the effects of other policy measures in Chapter 5. Here we will only note those examples that are of particular interest for our discussion on policy evaluation in the next section. First, we argued that tax policy has tended to raise the

quality of the WE in individual firms, and secondly that it has discriminated against activities with low-quality WE.

6.2 Some Suggestions for Policy Evaluation

Up to this point, the purpose of the analysis in this study has been to indicate the probable effects of different policy measures. To evaluate these policy measures is an entirely different matter. It is beyond the scope of this study to discuss the theoretical and empirical difficulties involved in such an undertaking. At the theoretical level, there is the fundamental question of how and with what one should measure the desirability of a policy measure and also compare different policy alternatives. The present analysis has been confined to the structure of the incentives generated by public policy. In the case of an evaluation, one would (probably) want this to be supported by the empirical investigations of these effects. These are just some of the more obvious difficulties with a proper evaluation.

If one furthermore wants to take account of the issues raised by Scitovsky (1976), the task does certainly not become less difficult. We have implicitly assumed that individual preferences do not change over time. This assumption is not correct according to Scitovsky. On the contrary, they are affected by the experience of the individual. (Note that this is conceptually different from our assumption that the utility function depends on the state of the world.) One implication of his analysis is that changes, for example in the WE, are valued in their own right in a society like ours. Thus, a "good" WE today would automatically be less valued tomorrow by the same individual employee (while it may be higher valued by someone just entering it). Obviously these kinds of complications raise problems at both the theoretical and the empirical level.

Nevertheless, it is my impression that many would find the reading rather disappointing without a section in that vein. Furthermore, it is instructive to see what kind of evaluation results we might expect from a given set of assumptions. Moreover, it would be interesting to see what kind we do not necessarily expect. However, given the limitations discussed above the analysis to follow must be interpreted cautiously. The results should be treated as indicating fruitful areas of future research, rather than as policy proposals. As indicated by the title to this section, we will certainly not endeavour to discuss all possible issues here. We will be content with some major examples.

There are essentially no Pareto sanctioned improvements to be proposed, if only for the reason that we have not yet been able to identify with certainty winners and losers from a change. In the greater part of this section, we will assume that some sort of "potential Pareto improvement" test is operative. However, we will also discuss the concomitant use of other goals, such as decreasing injury risks or risk equity. With respect to occupational hazards, the use of the potential Pareto improvement test normally involves basing the evaluation on individuals' preferences at the time of the decision. However, this is not necessarily a correct procedure, and we will discuss an alternative view in the final part of this section.

Work Environment Policy as Potential Pareto Improvement

We begin this section with a policy evaluation in the traditional vein. The same structure is used as in Chapters 2 and 3. I.e. we begin at the most aggregated level, and finish with the situation of the individual employee.

Resource Allocation between Industries and Firms

We begin our discussion with the issue of resource allocation between firms and industries. It appears that much of the WE policy discussed here tends to favour companies and activities with a relatively low quality WE (in terms of the physical shaping). In our analysis of WE policy, a number of characteristics were identified that are to the relative advantage of these companies, albeit naturally to a varying degree. These are not likely to be fully counterbalanced by other features of the WE policy.

The financing of the WII and of the HI tends to bias the allocation of resources towards industries with high-risk and low quality WE. It is difficult to ascertain the effect of the WE "regulations" in this respect. To the extent that it is to the disadvantage of employers, capital will move away from this sector. On the other hand, it is likely that the public financing of the ASS and the YI represent a subsidy to the same industries. Finally, public support to research and information concerning the WE should again mainly favour the high-

risk sector.

However, the above conclusion can absolutely not be taken at face value as a policy recommendation. Before turning to policy evaluation, it is necessary to take the effects of other kinds of policy into consideration. (We also remind the reader that our "definition" of WE policy is essentially arbitrary.) In particular, we argued that the Swedish tax policy produces a bias in the opposite direction; i.e. to the disadvantage of activities with low quality WE.

The only attempt to estimate the possible welfare loss due to the allocative effects of financing Social Insurances by uniform payroll taxes is Hansson, Lyttkens and Skogh (1984). The results must be viewed as a first step in this direction since this analysis only deals with a two sector model. The welfare loss is estimated to fall between 36 million SEK and 442 million SEK.¹ As argued above, this "misallocation" is counteracted by the effects of the income tax, to which we now turn.

Duncan and Holmlund (1983) found compensating wage differentials of the magnitude of 2-4% in the early seventies in Sweden.² While problems remain for the interpretation of these results,³ it seems reasonable to use them as a first indication of the magnitude of the wage differentials that might be found. It must be noted that the material refers to the period 1968-74; i.e. before the enactment of much of present day WE regulations.

Let us proceed under the assumption that a firm with a "bad" WE pays a wage premium of the magnitude of 2-4%. Taking account of the payroll tax and collectively negotiated wage-surcharges (in total c. 40%), the wage-bill for the company is increased by 2.8-5.6%. We base our calculations below on data from 1979, assuming that the size of the wage premiums may have been of a comparable magnitude that year. Given a marginal personal income tax rate of 50%, a 1.0-2.0% wage premium is due to the income tax. Without the tax, the firm could have compensated its employees with a wage premium of the magnitude of 1.0-2.0%. This premium would have increased the wage-bill by 1.4-2.8%.

Next, we turn to the WII and the HI. For different branches of industry, expenditure on occupational injuries as a percentage of the wage bill ranges from 0.05% to 2.73%.⁴ This includes the WII, health care costs, and sickness cash benefits formally paid by the HI. The most difficult item is sickness absenteeism related to the WE. How much do activities with low quality WE gain from the uniform payment for these benefits? The highest possible value would presumably be obtained by assuming that all sickness absenteeism in excess of the one found in the least affected industry is induced by the WE. Taking this view, and adding the costs of occupational injuries, we obtain the "correct" tax rates for the highest and lowest paying industries: 5.6% and 15.3% of the wage bill, respectively. This may then be compared with the premiums actually paid. The payroll taxes for the HI and the WII are 10.6% and 0.3% respectively (or rather they were at this level in 1979). Firms in the highest-cost industries would thus save $15.3\% - 10.9\% = 4.4\%$ of the tax on the wage bill. If we only consider occupational injuries, a uniform payroll tax that would have covered the items mentioned above would amount to 0.7%. Hence excluding sickness absenteeism, the minimum saving in highest-risk industries is $2.7\% - 0.7\% = 2.0\%$.

In our hypothetical example, a company with a dangerous WE in relation to another with a safe WE is burdened with a 1.4-2.8% premium on its wage bill because of the income tax, and gains 2.0-4.4% because of the method of finance adopted for the WII and the HI.

These figures serve to illustrate the problem that we are facing. Although this is a very simplified example it should be sufficient to substantiate the contention that we have much to learn before this line of reasoning can lead to policy recommendations. Public policy measures undoubtedly influence the allocation of resources between activities with high and low quality WE. However, the effects that we have described work in opposite directions. We do not know which one will be predominant. In fact, the effects might even cancel each other out.

Resource Allocation within Firms

We now turn to resource allocation within firms. It was concluded in Chapter 2 that the Social Insurance system decreases the amount of WE investments that reduce occupational injuries and sickness absenteeism. This may have been counteracted by the WE regulations and by the WE investment subsidies. Furthermore, if employees underestimate the risks they face, they will demand lower compensation, and the WE quality will be lower than with correct risk perceptions.

It might be tempting to ask: ought we to increase (further) the quality of the WE through public policy? Again, one would have to take account of non-WE policy factors. On the one hand, employees may underestimate the risks with which they are confronted. This would lower WE quality. On the other hand, we argued in Chapter 5 that the tax policy provides a strong incentive to increase it. (Thus, it might even be concluded that regulations ought to be used to prevent increases in WE quality.) There are obviously many other factors involved.

However, we will not endeavour to solve this problem. Instead we will discuss a more limited issue: given that we wish to increase WE quality through public policy, which method should be adopted? The answer to this question obviously depends on the alternatives available, and also on the kinds of WE characteristics at which we are aiming.

It is important to keep in mind the assumption that an increase in WE quality is desired. For example, below, we will discuss the case of taxes to influence decisions in a contractual relationship. With costless contracting, a Pigovian tax on an externality will distort resource allocation rather than improve it, as is well known (Coase, 1960). The same could happen, mutatis mutandis, with a tax on occupational hazards. However, here we have assumed a desire to increase the WE quality, given the contractual relationship.

One policy approach is to exert influence via the employee. If employees underestimate the dangers in the WE, than one method of inducing higher WE quality is to improve the information that is available to them.⁵ The impact of the preferences of the individual employee may also be strengthened. This could be done by striving for "full employment" and mobility on the labour market (Ahonen, 1981, p.

77).⁶ If it is easy to change employment without losses, then the bargaining position of the employees as a group is strengthened. Thus, their remuneration would be likely to increase, *inter alia*, in terms of increasing WE quality. In addition, this implies greater opportunities for the individual employee to move to a WE that suits his/her preferences (not necessarily a better one). This is important since WE characteristics are often in the nature of (local) public goods (cf. section 5.4).

This kind of policy is essentially non-interventionist. Swedish policy aimed at increasing WE quality has been of a rather more interventionist nature. Arguably, WE regulations should be seen as such measures. It is interesting to compare regulations with the use of more direct economic incentives. In Chapter 3, we made some general notes on the possibility of the use of taxes and subsidies in WE policy. We argued that subsidies may well be used to increase the level of positively valued WE characteristics. However, in the present context, we are more concerned with negatively valued characteristics - especially occupational hazards. Regulations are after all primarily aimed at the latter. We saw in Chapter 3 that it is quite difficult to use direct subsidies to increase WE quality in this respect. However, it is possible to subsidize WE investments. This has been tried, and we analyzed the Swedish experience. (It turned out that investment subsidies carry some disadvantages as a policy measure in this context.) The use of taxes to increase WE quality remains to be discussed. There has been no experiment with such direct economic incentives in Sweden. Since investment subsidies are no longer used, we will compare taxes on negatively valued WE characteristics with regulations.

"Tax" should be understood in very general terms as something to be paid for injuries. It may equally be termed an "injury fee", a differentiated insurance premium, or indeed a strict employer liability for the company with respect to (certain) occupational accident costs (cf. Skogh (1982), and Smith (1976), pp. 78-83).

As we shall see, the applicability of the tax approach varies according to the WE characteristic under consideration. We will discuss occupational safety first, then occupational health, and finally other WE characteristics.

Compared to regulations, an injury tax on occupational accidents has many advantages if the objective is to increase occupational safety. There are two basic possibilities here: to tax the risk of occupational accidents, or to tax actual accidents. The risk is the more inclusive concept. Not only does the risk lead to actual injuries, but the risk is unpleasant in itself. However, it seems impossible to tax the risk for occupational accidents.⁷ For example, how would you measure it? Accidents occur as the result of a complex interplay of many factors.

On the other hand, it is relatively easy to tax actual accidents.⁸ Indirectly we have already discussed this kind of policy, when we described the effects of the Social Insurance system as opposed to one with more differentiated premiums. Hence one way to introduce an injury tax would be to change the financing of the WII and the HI to an experience rated system. Such a policy change has been advocated on several occasions as a means of increasing occupational safety and health.⁹ Company payments would then vary in accordance with the proportion of these expenditures that falls on their workforce. It is my contention that this would constitute a useful instrument in a policy for increased WE quality. Experience rating would create (increase) direct economic incentives for accident prevention.

It is a well-known argument from economists that "putting a price on the environment" is more efficient than using (uniform) regulations.¹⁰ Presenting companies with a "price-list" for the social harm they cause, will (ideally) make every company choose its efficient level of harm reduction. As discussed in Chapter 2, a uniform regulation does not generally induce such efficient choices. In addition there are the problems associated with the enforcement of compliance with the regulations (cf. section 3.5). This often takes the form of a negligence system based on fines. The latter can be viewed simply as stochastic fees for engaging in a dangerous activity. Compliance is therefore by no means certain, and this raises a number of questions regarding the suitable structure of the enforcement system.

However, the argument does not apply in this simple form in the case of Swedish WE regulations. We saw in Chapter 3 that these regulations are not uniform. In particular, the costs of WE improvements are to a certain extent considered by the authorities. However, a convincing

case can be made for using direct economic incentives rather than regulations to induce higher WE quality, even if we envisage a situation where the enforcer tries to take full account of costs and benefits. (To the extent that we are dealing with more "traditional" forms of regulation, the argument for the tax approach is generally stronger.) We begin by stating the argument in a rather general form, and turn to some practical issues later.

Today, the weighing of costs against benefits of WE improvements is made by the labour inspectorate. We argued in Chapter 3 that this is not likely to be very accurately done. Partly, this is due to a lack of information on the benefit side. Such information is also required by a tax system, and could equally well be given to inspectors. The benefit of the latter system is that the estimation of costs for WE improvements is made at the level of the individual company, where this type of information is generally more accurate and readily available.

An inspector can only deal with those WE factors that come to his attention during an inspection. This means, for example, that many occupational hazards will go unnoticed. Many more factors will be dealt with if the employer or his representative are motivated to deal with them as part of the ordinary supervision of the workplace. Thus, all kinds of accidents will be prevented, not just those considered by the regulator or the enforcer.

Neither does the tax have the lets-wait-and-be-inspected property of many other control systems.

Finally, regulation is essentially an ex post phenomenon, and this is of significant importance. This implies that regulations will have less influence than direct economic incentives on the companies in their research and development. For example, if negatively valued WE characteristics are not particularly costly for firms, technological developments will be biased towards solutions that embody a relatively large amount of these characteristics. In addition, the cost of achieving a certain level of injury prevention, is usually higher when it involves the modification of an already developed technique. This cannot be fully counteracted by ex post incentives, such as a regulation. They have to take the new technique as given when weighing the costs of WE improvements against benefits, and usually deal with

existing rather than future WE characteristics. It is of course probable that the threat of future regulation influences company planning, but I would suggest that it is ineffective in relation to the direct cost internalization policy.

For reasons such as these, economists and others have argued that variants of the injury tax approach is superior to regulations as a policy tool to promote workers' protection (e.g. Nichols and Zeckhauser (1977), Smith (1974; 1976, ch. 5), Viscusi (1983b, pp. 115-117, and 156-168)).¹¹ We may also note that it would simplify matters with respect to research and information policy. As noted before, the present financing of the Social Insurance system lowers the private return to these activities.

Let us now turn to some more practical aspects of changing WE policy in this manner. The simplest change would be to retain the WII and the HI in their present form with the exception of the financial arrangements. We could call this an introduction of differentiated insurance premiums. (More complete merit rating as a means of increasing workplace safety has also been frequently discussed.¹²) Basically, the same amount of taxes would then be collected, and the compensation of the employees would remain the same. (For example, the property of quick payments to employees could be retained.) Only the burden of the tax would be placed differently. Companies would then face widely differing costs depending on their injury record, etc. A rough estimate of the public expenditures¹³ related to occupational injuries¹⁴ is 2 billion SEK for the year 1979 (see Appendix 2). This represents 3% of the operating surplus in the Swedish economy that year. Probably, re-allocating parts of these costs among companies would produce non-negligible increases in injury prevention, especially in the long run. It is worth pointing out that it is very unlikely that any firm will decrease its prevention activity because of such a change. The companies that would pay less under a system of experience rating would also have increased prevention incentives - a uniform tax has been transformed to controllable costs.¹⁵

By means of a tax on individual accidents, it is possible to give any amount of incentives for preventive measures by firms. A tax schedule would then represent the benefits of avoiding accidents. Since the government acts as a "middleman", the benefits paid out to employees need not coincide with the taxes contributed by the employers. For

example, the latter can be raised to induce further increases in the level of accident prevention.

Throughout our analysis we have assumed that both employer and employees can influence the probability of accidents. Because of the existing contractual relationship it is possible to achieve a certain level of prevention by placing costs on one party only. The share of costs and the prevention of each party will then be determined internally. (In the literature on liability, this appears as a case for strict liability on either one of the parties.) In particular, it makes sense to place additional costs on the employer. The company is the better insurer, and the employment contract generally allows the employer to monitor the behaviour of the employees. It should be noted that it is difficult for a regulatory agency to prevent accidents that are due to employee behaviour. If these accidents are to be reduced, nobody is in a better position to do it than the employer, or the employee himself. (This does not mean that all occupational accidents could ever be avoided, as long as human beings are involved in the production process.)

To introduce an injury tax would probably affect the hiring policies of firms. We noted in Chapter 2 that the non-differentiation of insurance premiums lessens the return to screening of would-be employees. This would now be changed.

Like regulations, an injury tax requires enforcement. However, I suggest that it would be less costly and more effective. Naturally, it would depend on the incentives and possibilities for cheating. The provisions for the HI will be of importance here. If payments for sickness absenteeism are not experience rated (cf. below), companies may try to report occupational accidents as "normal" absenteeism.¹⁶ This tendency would be counteracted if employees receive higher benefits as victims of occupational accidents. However, it may be thought better not to have a system that creates this conflict between employer and employees. (The latter may not always have their rights respected.)

Finally, we note that in terms of practical policy, a tax on accidents would probably have to be constructed so as to avoid large fluctuations in company expenditure. One would not want the existence of companies to be jeopardized by stochastically occurring accidents

(Skogh, 1977a,b; Viscusi, 1983b, p. 91). Neither would it be desirable to have fluctuations of a magnitude that make the employer exhibit risk aversion in his decisions. This could have undesirable effects on their preventive activity, as is discussed in relation to fines in Chapter 3.¹⁷ Furthermore, if parties are incapable of paying for the full magnitude of harm done, they would probably not have adequate incentives to control risks (Shavell, 1984a,b). To avoid these effects one could, for example, base the tax on a three-year average.¹⁸ This would decrease the return to preventive activity, since some returns would fall in the future. But this effect could be counteracted by increasing the tax rate. Another possibility is that firms buy liability insurance against these expenditures (Skogh, 1977a,b).

We have now concluded our discussion on the question of an injury tax on occupational accidents. The discussion has been rather extensive. However, this allows us to be quite brief when discussing the use of "taxes" with respect to other WE characteristics, since the arguments are often very similar.

We turn now to occupational diseases. The general arguments for using direct economic incentives rather than regulations to increase WE quality are the same as for occupational accidents. (But note in this case employees are probably more likely to underestimate the risks that they face.) However the practical problems are different.

In the case of occupational diseases, it does not seem possible to tax the actual injuries (Smith, 1976, p. 83). An employee who has an occupational disease may have had several employments. It will often not be possible to determine during which of these employments the disease was developed. Furthermore, several employments may have contributed to the disease, as well as factors outside the workplace.

In many cases it will obviously not be possible to tax the risk either. On the other hand, there are some instances where it may appear tempting to try to tax the risk. For example, with airborne substances, the analogy with effluent charges in the natural environment lies near at hand (Nichols and Zeckhauser, 1977).

It is exceedingly difficult to determine a reasonably "correct" tax schedule for the emission of harmful substances.¹⁹ In particular, in relation to harmful substances in the WE it is not just a question of how much is emitted, but also of when, where, and how. The amount of harm depends critically on the number of persons exposed, how they are protected, for how long they are exposed, how often they are exposed, etc. Many of these factors can be changed at short notice. If the aim is only to decrease emissions to some specified level, some of the difficulties are avoided. (Such a procedure is suggested by Baumol (1972) with respect to pollutants.) However, even with this limited ambition it seems highly doubtful whether the administrative costs (setting prices and subsequent control) of such a system could be kept within reasonable limits.²⁰ Smith (1976, p. 83) ascertains that it could not.

Nevertheless, there are some cases where it seems possible to tax the risk of occupational disease. One such case would be if a production process requires a fixed number of personnel in fixed positions. For example, suppose there is harmful radiation from computer screens. There is a whole category of employees who usually spend their working days sitting in front of a screen (e.g. in the insurance business, in travel agencies, secretarial work).

Or, take the example of substances that are so harmful that the policy goal is that they should not be used at all. This is the case with asbestos. At present, there is a general prohibition against its use. Exceptions are made, however, when there is no possible substitute. In this case, one could use a tax on the amount bought by the company. This would probably be a more efficient way of (eventually) eliminating its use (disregarding other effects).

However, it seems that the opportunity to use taxes in relation to occupational diseases is the exception rather than the rule.

Finally, we will discuss the possibility to use direct economic incentives to promote higher WE quality with respect to other dimensions than occupational injuries. It is manifestly inconceivable to impose a tax on "bad" WE in general. We have to look for more specific taxes, such as the ones on accidents and diseases discussed

above.

The one example that we will discuss here is to concentrate on sickness absenteeism. We argued in Chapter 2 that this will be higher in companies that have low quality WE, ceteris paribus. One way in which to promote higher WE quality is therefore to introduce differentiated payments to the HI. This differentiation would encompass all "above normal" sickness absenteeism due to the individual's own illness. (Absenteeism for other reasons that is also compensated through the HI should not be included.²¹) Obviously, this is not a direct measure in the sense of the "taxes" discussed above. Nevertheless, it merits consideration.

Differentiated payments for sickness absenteeism will increase employers' incentives to reduce absenteeism. As in the case of payments for occupational injuries this can be accomplished in a number of ways. One method is the present objective - to increase the WE quality by decreasing occupational hazards and other negatively valued WE characteristics. It can also be sought by increasing positively valued characteristics. Thus, this "indirect" WE tax can promote WE improvements in that dimension as well. This may be almost the only policy measure that can influence less tangible psycho-social aspects of the WE (that is, apart from working hours, wage form, and such). However, we must also be aware here of the other effects that we instigate. We know also that there are much larger sums involved here - the uniform payroll tax that helps finance the HI is 9.5%.

A discussion here would largely reiterate what has already been said. We only note the effects on the hiring policies of firms. These would be affected in a similar way as with the "injury tax". However, there are differences in magnitude. While accident prone persons could probably get a job in low-risk industries, persons prone to illness would find it difficult to get any kind of job (even more difficult than today), or only with lower pay (cf. Skogh, 1977a,b). Our attitude towards an "absenteeism tax" will therefore depend on how we value this type of effect.

This concludes our analysis of the use of taxes to increase WE quality. We noted in Chapter 2, a great many effects of using uniform rather than differentiated payments to the WII and the HI. Since the injury tax is equivalent to a system with experience rating, these effects will be reversed. If the tax is imposed at a higher level than warranted by the financing of the present Social Insurances the reversal will move us beyond the situation with differentiated insurance premiums. Since the effects in question were summarized above, in the first section of this chapter, we will not take up space by presenting them here.

In Chapter 3, the effects of the WE regulations were discussed. Our discussion in this section implies that at least some regulations may be abolished upon the introduction of an injury tax. To the extent that this happens, the effects of the regulations will of course disappear.

We saw above that the merits of the tax approach are likely to vary according to the WE characteristic under consideration. For example, its usefulness with respect to occupational diseases was quite limited. This highlights the importance of the "non-interventionist" labour market policy discussed above (pp. 224-225). There may also remain areas where regulation is the favoured policy. Naturally the tax can be combined with regulations.²² For example, Nichols and Zeckhauser (1977) have suggested that an upper limit for acceptable risk levels should be specified in such a system. Regulations could also be used to decrease the probability of "catastrophic" events. This may be desirable inter alia because companies may have quite limited incentives to deal with these risks, since they are incapable of paying for the full magnitude of harm done (Shavell, 1984a,b). An interesting question is whether dangerous but profitable industries should (be allowed to) continue to operate. The heart of the matter is then whether there are limits to how much people should be allowed to engage in dangerous activities. We will return to that question in the subsection on limits to individual risk-taking.

One final point deserves to be made. Above, we discussed the allocation of resources between firms and industries. As indicated by that analysis, a change in that allocation may or may not be desirable. It would in any case certainly be changed by the injury tax. A hitherto unmentioned aspect of this is the effect that it would have on foreign trade. As an illustration of the interdependence between the WE and other policy areas, this merits a short

digression. The present financing of the benefits paid to victims of occupational injuries could be seen as a less obvious way of subsidizing the export/import industry. This is shown in Table 6.1. 70% of the total exports plus imports stem from industries which give rise to public expenditures related to occupational injuries that are above the average for the economy as a whole. For total exports, the corresponding figure is 72%.

Table 6.1: Exports and imports in relation to public expenditure for occupational injuries per industry in 1979

Industry (SNI code)	Exports + imports	Exports	Public expenditure related to occupational injuries	
			above the average for the whole economy	below the average for the whole economy
11	5,353	1,071	x	
12	710	177	x	
13	288	208	x	
21+29	1,440	248	x	
22	10,211	86	x	
2301	1,638	1,633	x	
2302	1,500	622	x	
31	8,416	2,048	x	
32	13,511	3,442	x	
33	10,097	7,951	x	
341	18,209	17,124	x	
342	1,306	585		x
351	13,382	4,601	x	
352	6,552	3,019		x
353+354	19,273	3,261		x
355	2,332	880	x	
356	2,026	724	x	
36	3,213	1,323	x	
37	18,240	10,935	x	
381	12,396	6,322	x	
382	33,784	20,043	x	
383	17,148	9,002		x
3841	3,695	2,265	x	
384 excl. 3841	25,399	15,689		x
385	5,050	1,981	x	
39	1,951	602		x
4	787	386	x	

Note: Exports and imports in million SEK, current prices. Public expenditures for occupational injuries evaluated in relation to wage sum.

Sources: Foreign Trade 1980, Part A, table 2.

Appendix 2 to this study.

In the long run, changes in the exchange rate may tend to eliminate this advantage for non-sheltered parts of the economy as a whole. There would still be large net-gainers among specific firms and industries, since there are large differences in "subsidies" from the uniform financing between and within the industries in Table 6.1. (Cf. Appendix 2, Table A2.2, p. 292.)

This would place a number of Swedish companies in a favourable position compared to competitors in other countries, in so far as the latter are burdened with more "correct" payments. At the very least, these Swedish "export companies" will be in an inferior competitive position compared with the present if we introduce the injury tax. Domestic WE policy can thus be used as a tool in trade policy. (N.b. international WE policy can also be used as an instrument of trade policy, as analyzed by G. Hansson (1983).) Domestically, there will be similar effects in terms of regional policy. The "subsidies" in the present system are not uniformly distributed across regions in Sweden.

The Situation of the Individual Employee

The final issue to be discussed in relation to policy evaluation is the situation of individual employees. We confine our discussion to the compensation of injury victims and sickness absenteeism. The present compulsory system gives practically complete coverage for income loss during sickness absenteeism and for minor occupational injuries. We argued that this represents an over-insurance for large groups of people, in the sense that they would not have been willing to pay for it individually.²³ In fact, since individuals have different risk aversion, it is a feature of any compulsory system that the greater the difference between the level of coverage and the minimum standard of living, the more people will be overinsured (Söderström, 1983). With the present level of coverage, it is likely that there are important moral hazard effects, at least as regards sickness absenteeism.

Is this public intervention in the insurance market called for? If employees underestimate the probability that they will need insurance coverage, they will underinsure (Diamond, 1977). This means that their expected utility could be raised by making a higher coverage compulsory.²⁴ However, this tendency is counteracted by the progressivity of the income tax. With increasing marginal tax rates there is an additional benefit from equalizing before tax income across different states of the world. (This supposes that sickness cash benefits are taxable, as they are in Sweden, and that the insurance premiums are deductible.) It seems therefore doubtful

whether the above constitutes a good argument for intervention. Even if it is considered that higher coverage would be desirable, the appropriate policy need not be a compulsory Social Insurance. One could subsidize this kind of insurance. Thereby the coverage would increase, but each individual could choose a desired level of coverage. However, in order to avoid the free rider problem, compulsory coverage equivalent to the minimum standard of living should always be retained (Söderström, 1983). However this need not necessarily take the form of social insurance.

The above also holds if individuals derive utility from the insurance coverage of others. However, if there are merit wants, this may of course change the situation.

Suppose we introduced a market solution to the insurance of individuals in these respects. The premiums would then tend to be differentiated with respect to individual characteristics and WE characteristics. (The former may be thought to include both personal characteristics and aspects of the individuals non-work environment and social situation.) Such differentiation would take place if it is cheap enough to identify and measure these characteristics. The differentiation by WE characteristics will in the end be paid by the employer (high premiums being a disadvantage of working in a particular firm), and this would give us experience rated payments by firms. The implications of this has already been discussed. As previously noted, it is in fact possible that the employer will act as an insurer. Whoever insures the individual employee, there may be problems with adverse selection. This stems from the fact that premiums per individual should vary with the characteristics of the individual. If these characteristics are not observable, the insurance market may collapse.²⁵ On the other hand, if these personal characteristics are cheap enough to identify and measure, "sickly" and "accident prone" persons will have to pay more for their insurance coverage.

Of course, there are ways around these effects if they are not desired. Differentiation by firm or person may be avoided either by the state acting as insurer, or by prohibiting such differentiation. Subsidizing of the premiums could eliminate adverse selection.

A rather good case can thus be made for extensive changes in the present system. Even if these Social Insurances are retained in an essentially unchanged form as regards the insurance of the employee, it appears that the coverage should be decreased. At least, this is the case for sickness absenteeism. Differences in coverage between this case and occupational injuries contains an inherent disadvantage. There will be a tendency to misreport "ordinary sickness" as occupational injury. One may therefore want to have the same coverage in both cases; presumably by decreasing coverage for injuries.

Limits to Individual Risk-taking

The analysis in this study has been based on individuals' preferences concerning their own situation. It is conceivable that this underestimates the social benefits from improvements in the WE. Individuals may have merit wants regarding this. There might also be positive externalities associated with an increase in WE quality - in other words, that people derive utility from the fact that others enjoy a better WE. Both these effects would increase the desirability of measures that lead to increased WE quality. We will now explore the implications of this viewpoint.

The area of injury risks might be important in these respects. Whereas merit wants only concern individuals and their preferences, the existence of positive externalities concerns a relationship between people. The heart of the matter is then whether people should be allowed by us to engage in dangerous (risky) activities. It is natural to widen our perspective to include non-market time. The same principles should presumably apply to both market and non-market time. (Differences in the risk-taking allowed should be explained by the characteristics of the market and non-market situations.)

The degree to which we accept that others take risks probably depends on a number of factors. Obviously, there will be limits to risk-taking that at the same time endangers other people. (This is a variant of the familiar concept of negative externalities.) More interesting is the case where individuals only puts themselves at risk. One of the most important factors in that case is probably the extent to which the action is voluntary. I will not endeavour to carry out a comprehensive discussion of "voluntariness". This is a very intricate

problem in itself. Nevertheless, I would argue that there is a widespread agreement as to which actions are voluntary and which are not. Furthermore, I contend that this "common sense" notion of "voluntariness" is important for our judgement concerning the acceptability of risk-taking behaviour. The argument is that the more intervention is called for, the more non-voluntary is the risk.²⁶

In the context of the WE, there are two aspects of voluntariness that must be noted. It is suggested here that these belong to the common sense notion of the concept. First, for a risk-taking action to be voluntary it is essential that the individual is well-informed concerning both the action in question and alternative actions (Möller, 1983, p. 11). Secondly, risk-taking is often a process that can be decomposed into minor actions. Full voluntariness requires that the individual has a free choice in deciding on each sub-action. We could call this controllability (cf. Chelius, 1977, p. 3). The greater the number of steps in the risk-taking process that are under the individuals control, the more voluntary and thus acceptable the risk is.²⁷ This is still a very loosely outlined argument, but it will suffice for our purpose. In Table 6.2 we have illustrated this argument in relation to several different risks.

For a risk to be voluntary it must also be understood (Möller, 1983, p. 11). Therefore provision of information may be called for. By making risks voluntary, this would make them acceptable.

One crucial question is obviously how voluntary the occupational risks actually are. A person who has entered an employment contract has generally less freedom during working time than during non-working time (Chelius, 1977, p. 3). The employment contract is typically open-ended. It places the employee under the obligation (within certain limits) to follow the orders and instructions of his employer.

Table 6.2: The degree of voluntariness in risk-taking as a function of controllability

step no.		voluntary risk	semi-voluntary risk	non-voluntary risk
I	innate pre-requisites for being able to take risk	cognitive abilities	innate qualifications for job	being born non-resistant to infectious disease
II	decision that enables individual to take risk	learn theory for driving MC	education, training, etc., for job	-
III	decision to take risk sometimes	decide to actually drive MC	seeking job	-
IV	decision to take risk at particular point in time	drive MC	going to work	-
V	decision that influences the degree of risk	decide on speed	avoiding or not avoiding dangerous situations at work	-

I would suggest that there is (normally) a high degree of freedom in the initial choice of occupation (step II, and to a lesser degree III, in Table 6.2). Thereafter, the degree of freedom in taking risks should in my view be considered highly limited, in the present context. At the workplace, the employee is obliged to follow the directives of the employer. To change occupation and/or employment is costly, for a number of reasons.

In addition, it should be noted that many occupational risks will often only be understood, or come to the knowledge of the employee, after a period of employment. The initial freedom of choice is therefore of less value.

I would consequently tend to the view that occupational risks are often non-voluntary in nature. Consequently, it may be concluded that government intervention may be called for to decrease these risks. Whether such a policy should actually be implemented depends inter alia on the cost of achieving risk reductions, and on the size of existing risks.

If a task is too dangerous for everybody, the policy should be directed towards its abolition. On the other hand, if it is only dangerous for some persons, or if only some persons are likely to hurt others, then it might be better to make sure that only "the right" persons perform it. This would imply that only non-smokers should hold certain positions, such as asbestos work. There is also the possibility to forbid pregnant women (or even women in fertile ages) to perform certain tasks.²⁸ To prohibit the dangerous task carries the disadvantage that low-risk performers are denied from holding these jobs. On the other hand, it might be cheaper than differentiating between low-risk and high-risk individuals.

An obvious alternative to lowering occupational risks is to make these risks more voluntary. This could be done in a number of ways. One would be to introduce a compulsory unemployment insurance that guarantees, say, 80% of net of tax income. Another possibility would be to subsidize training, moving to other localities, etc. Also, the legal system could be restructured to facilitate mobility in the labour market.

It has been contended that "risk equity" has an intrinsic social value (Linnerooth, 1982). From an ethical point of view it has been convincingly argued that non-voluntary risks should not be too unequally distributed (Möller, 1983, p. 9; cf. Appendix 3). We argued above that occupational risks in Sweden are rather non-voluntary in nature. If we accept the risk equity argument, it appears to me that the existing differences in occupational hazards are too great to be tolerated. In particular, I would argue that this follows from the ethical argument.

An Alternative Perspective on the Value of Life

The question to be addressed in this subsection is how the government ought to act with respect to occupational risks. We confine our attention to risk of death. Elsewhere in this study we assume that "... social decisions should take account of individual preferences

and attitudes to risk as these exist at the time of the decision." (Jones-Lee, 1982, p. 284.) This tenet provides one principle for the evaluation of social decisions. Indeed, it is the usual one in economic analysis. In contrast, Broome (1978, 1982) has argued that this is unacceptable in relation to risk of death. In that case, the above principle has the implication that "... a 'statistical' life should be valued on different principles from the life of a particular person." (Broome, 1982, p. 214.)

Broome (1982) notes that if a government wishes to base its decisions on the preferences of individuals, it can do this in two ways. Remember from Chapter 1 that the outcome of an action is not certain, but depends on which state of the world occurs. When choosing between two actions, one option open to the government is to adopt the preferences of individuals over these actions - "endostochastic preferences". Or, one can instead use the individuals preferences over the possible outcomes of the actions - "exostochastic preferences".

We show in Appendix 3 that there is no a priori case for either point of view. Obviously, the evaluation of WE policy depends critically on the choice between endostochastic and exostochastic preferences. In this subsection, we will discuss some applications of basing government decisions on exostochastic preferences.

This exercise is given additional interest by the fact that non-economists (in my opinion) usually tend to think in terms of exostochastic preferences in relation to occupational hazards. Their concern is with the person actually injured or not injured - not with individuals' valuation of changes in risk. Therefore it is important to trace the implications of a consistent application of such a view.

It is not our intention to outline or discuss a fully developed set of policy measures. As will be seen below, a policy based on these principles might be rather different from the one in use, and from the suggestions elsewhere in this section. A full description would therefore take us far beyond the scope of this study. Rather, we will note some important aspects of basing a WE policy on exostochastic preferences.

We begin with the general implications of using exostochastic rather than endostochastic preferences. This means that we are essentially concerned with the situation ex post of the policy action. Ex post optimality does generally not coincide with ex ante optimality. This may be important for WE policy.

A not unlikely situation is the following.²⁹ The WE in a firm is in accordance with the wishes of the employees. However, the level of health and safety is based on the workers' subjective assessment of the injury risks. These are lower than the true probabilities. The government suggests a policy measure that would lead to lower risks. The cost of the risk-decreasing investments will fall on the employees in the form of foregone benefits of some other kind. Now suppose the suggestion of the government does not induce the employees to revise their subjective probabilities. On the basis of endostochastic preferences, we would unequivocally reject the policy measure. Otherwise all employees would in their own opinion ex ante be worse off.³⁰ With exostochastic preferences, the situation is different. There may be one or more persons that are saved from an injury. Their gain may be considered to outweigh the loss of the other employees.

This example hints at another potentially important aspect of the choice between endo- and exostochastic preferences. The distributional issue becomes a different one. The number of gainers from a risk reduction will be fewer - those actually spared an injury - but their gain will be greater. For hazards that could lead to serious injury or death, the gain from a risk reduction for the not-then-injured will be immense (cf. below).

We will now use the results derived in the final section of Appendix 3. Using an attractive set of assumptions, we investigate there somewhat more specifically, the policy implications of the "ex post principle". It is then not permissible to directly increase the risk of death by such a large amount for such a large group of people that it leads to the death of a "statistical person". When it comes to risk-decreasing decisions, the government (always) faces the same ethical obligations as one individual seeing another one in immediate peril. In addition, the degree of voluntariness in risk-taking may also be important in relation to the ex post principle (cf. the

discussion above, pp. 237-240).

We argued previously that occupational risks in Sweden are relatively non-voluntary. In the present context, this implies that great efforts should be made to decrease these risks. The acceptable risk level is probably much lower than the one existing today.

The injury tax was discussed above. Given the view taken here, the case for that tax is greatly strengthened. The cost of causing an injury should also be put much higher than warranted by a mere differentiation of the present insurance premiums. Relatively speaking, the disadvantages that this policy might entail would carry considerably less weight compared to the benefit of saving life. (N.b. as long as the disadvantage is not in the form of lives lost.)

As in the previous subsection, a policy alternative is to make occupational risks more voluntary in nature (cf. p. 240).

We note also that the degree of voluntariness in taking occupational risks varies between regions, occupations, etc. This provides a justification for allowing the local (regional, etc.) situation in the labour market to affect the degree of permissible risk. Thus, geographical variations in the WE are required.

Finally, we note an asymmetry that would be introduced into the WE policy. The present law (the AML) states that the WE should be satisfactory in relation to the social and technological development of society. In principle, this seems to imply that it could be allowed to get worse. In other words, if society witnessed a decline, we could (should?) allow more occupational risks. However, with the new policy, one could never introduce less stringent regulations. If we have a regulation, we can (almost) never allow it to be changed in the direction of permitting higher risks. This would be a risk-increasing government activity. We have concluded that this would not be permitted.

6.3 Concluding Remarks

In this study, we have shown some of the effects of a number of Swedish WE policy measures. We do not try to evaluate these effects. However, in section 6.2 we gave some suggestions for a future policy evaluation. We have tried to demonstrate that any such appraisal must take influences from other policy areas into account. Without that perspective it is not possible to say anything about the absolute changes in the WE brought about by any single policy measure.

In our discussion, we have contrasted the effects of policy with the well-being of the individual. Thus, we have basically abstracted from policy goals as presented by reformers, politicians, etc. Another kind of evaluation would have been obtained if the effects of the policy had been compared with such objectives.

Finally, it is worth emphasizing that human relationships constitute the probably most important aspect of the WE, as far as the welfare of individuals is concerned. The emergence of good relationships can to a certain extent be facilitated through public policy. For example, by ensuring that the physical shaping of the WE is a help rather than a hindrance. There is no denying, however, that an important aspect of WE quality in the wider sense is not, and never can be, the subject of public policy.

Notes to Chapter 6

1. The size of the welfare loss depends inter alia on the size of the "correct" taxes and on the elasticity of substitution between the sectors.
2. The 2% figure refers to a computed index for dangerous work. The higher figure refers to the dummy variable "Noise" (which is in the first case used in the computation).
3. The authors show that the wage change formulation reduces the bias in the estimates, and reduces the impact of certain measurement errors. They focus on the results obtained by using wage change equations with computed indices for job characteristics. However, their results with wage level equations and with dummy variables for job characteristics cannot be disregarded. True, they produce some awkward (contrary to expectation) results. But to use this as a reason for rejecting them totally would be to assume what should be proved.

Finally, the explanatory power of the wage level formulation is much greater with R^2 's slightly above 0.4. In the wage change equation, the R^2 's are around 0.15. On the whole a limited faith in these estimates seems justified.

The problem with the correct specification of the equation that relates wages to working conditions also remains unsolved, since the same data cannot be used for both formulating and testing the hypotheses.

4. For details of these calculations and the ones below, see Appendix 2. Note that we still use industry averages. The range of variation between individual firms is probably larger.

5. Ahonen (1981), pp. 74-77, Nichols and Zeckhauser (1977), Smith (1976), pp. 77-78, Viscusi (1983b), pp. 4 and 84-87. The latter suggests *inter alia* that the government publishes the names of the safest firms in different industries (op. cit., pp. 157-159).

6. Note that mobility may also lead to more occupational injuries. Namely, if more people end up in unfamiliar surroundings.

7. A similar observation is made by Just and Zilberman (1979), p. 148 n. 6.

8. Of course, by taxing actual accidents, you will induce companies to decrease the risk for accidents.

9. See, for example, Ahonen (1981), pp. 80-81, and (1983), pp. 18, 43 and 60, Chelius (1977), pp. 63-69, Jonsson (1974b), Skogh (1977a,b), Smith (1976), and Viscusi (1983b), pp. 159-160.

An overview of practices in different countries is given in Morgenstern (1982).

10. In the modern Swedish debate, the discussion of these issues was initiated by Dahmén (1968) for the case of the natural environment.

11. There are also dissenting opinions. Ashford (1985) expresses doubts as to the feasibility and effectiveness of this kind of measure.

12. See the references given in Chapter 2, n. 38.

13. The expenditures from the WII, sickness cash benefits to occupationally injured from the HI, and health care costs for occupational injuries (in addition to those paid for by the WII).

14. This includes diseases.

15. Cf. the analysis in Appendix 1.

16. Any system with an "injury tax" would have adverse effects on the reporting of injuries. This deterioration in public information is a price that would have to be paid for the increased WE quality.

17. This also avoids the asymmetry between taxes and subsidies noted by Just and Zilberman (1979).

18. In Japan, a system in this vein in 1977 gave rise to contribution rates ("payroll taxes") between 0.4% and 8.9% to cover workmen's accident compensation (Hiraishi, 1980).

19. Note that we do not refer to the question of how to weigh harm to human beings against "production costs", since this problem must be tackled under any system of WE policy.

20. The same conclusion was drawn in a Swedish government report as regards a correct fee schedule for the local (as apart from regional/national) effects of emissions of sulphur (see Mäler, 1980). This problem still looks simpler than the WE emissions.

21. This includes for example absenteeism during pregnancy and taking care of a sick child. It is of course conceivable that the latter possibility is more extensively used by people working in a low quality WE. However, to include such items in the system of differentiated contributions would almost certainly create more problems than it solves.

22. This is advocated by Ashford (1985), partly on the basis that the efficacy of economic incentives remains to be proven.

23. What individuals are willing to pay depend on many circumstances, for example their insurance coverage with respect to other occurrences. There is a general tendency towards "over-insurance" in the Swedish Social Insurance system (Söderström, 1983).

24. Whether this justifies an intervention is another matter. Cf. the discussion on p. 242.

Note also that under certain conditions social welfare can be increased by a government fiat that lowers the amount of coverage for risk-averse victims offered by a competitive market, thus increasing their prevention incentives (Shavell, 1979a).

25. The "good risks" feel that they pay too much, and do not take insurance. This process may progress to worse and worse risks.

26. In relation to the risks that we are willing to take ourselves, "voluntariness" is certainly important (Lindeneg, 1984, pp. 137-138). Chelius (1977, pp. 2-3) argues that we are personally less willing to accept risks at work partly because they are less voluntary.

The implications of the "voluntariness" of risks for government assessment of the value of health gains is discussed in Viscusi (1983b), pp. 110-112.

27. This accords pretty well with actual practice concerning leisure time risks. The prohibition of drugs, for example, can be (partly) explained by the low degree of control of the individual over steps IV-V.

Note that during non-working time, some risk-taking is prohibited/regulated because it puts other people at risk. This is the case for dangerous driving, for example.

28. "For many jobs involving strength, dexterity, and other risk-related physical characteristics, employers are very selective in filling positions. Sometimes this selectivity is related quite explicitly to the risk. Smokers are not permitted to work at the Johns-Mansville asbestos plant because they face a risk of lung cancer almost a hundred times greater than nonsmokers. Similarly, no women are permitted to work in the pigment paint division of the American Cyanamid Corporation because lead exposures pose considerably larger risks to pregnant women." (Viscusi, 1983b, p. 133.)

29. The situation is given only in outline. Since we are only concerned with the principle involved, we need not concern ourselves with the underlying assumptions.

30. If this was a potential Pareto improvement test the measure could be accepted, by arguing that one should use the valuation of individuals had they known their correct probabilities. This is not applicable here, however, since the individuals actually bear the cost of the risk reduction.

APPENDIX 1: MATHEMATICAL DERIVATION OF SOME BASIC RESULTS

In this appendix we will formally derive some of the results in the main text. Our primary object is one specific aspect of the WE, namely the occurrence of occupational accidents. (Much of this discussion is relevant also to occupational diseases.) Our main concern is to show that the Social Insurance system lowers the amount of injury prevention in individual firms. Some other results follow conveniently from the same analysis. For example, the effects of the payroll and income taxes on preventive activity. We also briefly study the effects on other measures that raise WE quality. The main results are summarized in propositions 1-4 and 1'-3', and in Table A1.1 (see end of appendix).

We use the basic model presented in section 1.3. The expression for profits, P , in the company becomes:¹

$$P = F(L-y, y) - (L-y)w(1+T) - pc - Ay$$

where

F is the production function in value terms (product price = 1)

L is the amount of labour employed

y is the amount of labour lost due to occupational accidents

w is the wage (or taxable pecuniary benefits generally)

T is the payroll tax

c is the amount of safety (units of injury prevention)

p is the (relative) price of one unit of safety

A is the direct average accident cost per unit of labour lost.

All functions are assumed to be "well-behaved" (continuous, twice differentiable, etc.). y is assumed to be a decreasing function of c , $y = y(c)$.² In addition, we assume the following (subscripts denote derivatives):

$$F_1 > 0, F_2 < 0, F_{11} < 0, F_{12} = F_{21} < 0, y_1 < 0, y_{11} > 0.$$

Thus, occupational accidents affect profits in three ways. First, they reduce the amount of labour available. Secondly, they reduce production through stops, destroyed machinery, etc., thus decreasing the average productivity of remaining labour. On the other hand, there is no obvious reason why accidents should directly affect the marginal productivity of labour. Hence, $F_{12} = F_{21} = 0$ is probably the best assumption. The next best would probably be to assume that injuries lower the marginal productivity of labour. In order not to be unnecessarily restrictive, we make the weaker assumption initially. Thirdly, there are direct accident costs unrelated to the production process. From our general framework, it follows that these would include insurance premiums or other compensation to victims of accidents.

CASE A

We will begin with a simpler version of the problem, to show the structure of the analysis. It will be discussed rather thoroughly. This will enable us to be brief later on. We write the expression for profits:

$$P = F(L) - Lw(1+t) - pc - Ay.$$

Thus we consider for the moment only the direct accident costs. We take c to refer to a (local) public safety good. The utility of the individual employee is then given by:

$$U = U(w(1-t), c)$$

where t is the personal income tax.

The utility function is assumed to have the following properties:

$$U_1 > 0, U_2 > 0, U_{11} < 0, U_{22} < 0.$$

For the present, the firm is assumed to be profit maximizing. The decision problem of the firm then becomes to maximize

$$(1a) \quad P = P(L, w, c) = F(L) - Lw(1+T) - pc - Ay$$

with respect to L , w and c , and subject to

$$(2a) \quad U(w(1-t), c) = U^0.$$

The constraint is due to our assumption that one employer cannot offer the employee a contract that gives less utility than the contracts offered by other employers, ceteris paribus.

Differentiating the Lagrangian (Z) yields the following first-order necessary conditions for maximum:

$$(3) \quad Z_L = F_1 - w(1+T) = 0$$

$$(4) \quad Z_w = -L(1+T) - \lambda U_1(1-t) = 0$$

$$(5) \quad Z_c = -p - Ay_1 - \lambda U_2 = 0$$

$$(6) \quad Z_\lambda = U^0 - U = 0.$$

Assuming that the second-order sufficient condition for maximum is fulfilled,³ we can now use comparative-static analysis to study how the optimal value of c is affected by changes in the exogenous variables. By converting (3)-(6) to a set of equilibrium identities, and taking the total differential of each identity in turn, we obtain the following system (horizontal bars over the endogenous variables and λ indicate that it is their values at the maximum):

$$(7) \quad F_{11}d\bar{L} - (1+T)d\bar{w} - \bar{w}dT = 0$$

$$(8) \quad - (1+T)d\bar{L} - \bar{L}dT - U_1(1-t)d\bar{\lambda} - \bar{\lambda}(1-t)[U_{11}(1-t)d\bar{w} - U_{11}\bar{w}dt + U_{12}d\bar{c}] + \bar{\lambda}U_1dt = 0$$

$$(9) \quad -dp - y_1dA - Ay_{11}d\bar{c} - U_2d\bar{\lambda} - \bar{\lambda}[U_{22}d\bar{c} + U_{21}(1-t)d\bar{w} - U_{21}\bar{w}dt] = 0$$

$$(10) \quad -U_1(1-t)d\bar{w} + U_1\bar{w}dt - U_2d\bar{c} = 0.$$

We will now study the effect of the Social Insurance system on prevention activity. This means that we focus on the effect on $d\bar{c}$ of a simultaneous decrease in A and increase in T . The insurance lowers

the direct accident cost for the company ($d\lambda < 0$), and are financed through a payroll tax ($dT > 0$). We will therefore derive an expression for $d\bar{c}$ in only dA and dT .

It is assumed that $dp = dt = 0$.

Solving (9) for $d\bar{c}$ we obtain⁴

$$(11) \quad [Ay_{11} + \bar{\lambda}u_{22}]d\bar{c} = -y_1 dA - u_2 d\bar{\lambda} - \bar{\lambda}u_{21}(1-t)d\bar{w}.$$

From (8) we get

$$(12) \quad d\bar{\lambda} = \frac{1}{u_1(1-t)} [-(1+T)d\bar{L} - \bar{L}dT - \bar{\lambda}u_{11}(1-t)^2 d\bar{w} - \bar{\lambda}u_{12}(1-t)d\bar{c}].$$

Substituting for $d\bar{\lambda}$ in (11) we get

$$(13) \quad [Ay_{11} + \bar{\lambda}u_{22} - \bar{\lambda} \frac{u_2}{u_1} u_{12}]d\bar{c} = -y_1 dA + \frac{u_2}{u_1} \frac{1}{(1-t)} \bar{L}dT + \\ + \frac{u_2}{u_1} \frac{(1+T)}{(1-t)} d\bar{L} + [-\bar{\lambda}u_{21}(1-t) + \bar{\lambda} \frac{u_2}{u_1} u_{11}(1-t)]d\bar{w}.$$

From (7) we get

$$(14) \quad d\bar{L} = \frac{1}{F_{11}} [(1+T)d\bar{w} + \bar{w}dT].$$

Substituting for $d\bar{L}$ in (13) we get

$$(15) \quad [Ay_{11} + \bar{\lambda}u_{22} - \bar{\lambda} \frac{u_2}{u_1} u_{12}]d\bar{c} = -y_1 dA + [\frac{u_2}{u_1} \frac{1}{(1-t)} \bar{L} + \\ + \frac{u_2}{u_1} \frac{(1+T)}{(1-t)} \frac{\bar{w}}{F_{11}}]dT + [-\bar{\lambda}u_{21}(1-t) + \bar{\lambda} \frac{u_2}{u_1} u_{11}(1-t) + \\ + \frac{u_2}{u_1} \frac{(1+T)^2}{(1-t)} \frac{1}{F_{11}}]d\bar{w}.$$

Finally from (10) we see that

$$(16) \quad d\bar{w} = -\frac{u_2}{u_1} \frac{1}{(1-t)} d\bar{c}.$$

Substituting for $d\bar{w}$ in (15) we obtain the desired expression for $d\bar{c}$:

$$(17a) \quad d\bar{c} = \frac{-y_1 dA + \left[\frac{U_2}{U_1} \frac{1}{(1-t)} \bar{L} + \frac{U_2}{U_1} \frac{(1+T)}{(1-t)} \frac{\bar{w}}{F_{11}} \right] dT}{[A_{Y_{11}} + \bar{\lambda} U_{22} - \bar{\lambda} \frac{U_2}{U_1} U_{12} - \bar{\lambda} \frac{U_2}{U_1} U_{21} + \bar{\lambda} \left(\frac{U_2}{U_1} \right)^2 U_{11} + \left(\frac{U_2}{U_1} \right)^2 \frac{(1+T)^2}{(1-t)^2} \frac{1}{F_{11}}]}.$$

The fulfilment of the second-order sufficient condition ensures that the denominator is positive in this expression.⁵ Let us first look at the denominator and assume for the moment that the numerator is positive. The first term shows that the increase in $\bar{c}$ is lower, the higher the initial accident cost and the quicker the marginal effect of safety on the number of accidents ($-y_1$) diminishes. The second term shows that $\bar{c}$ will increase less the quicker the employees' marginal utility of safety decreases as c increases. The third and fourth terms concern the effect of safety on the marginal utility of money, and vice versa. Note that an increase in c will be accompanied by a decrease in w , and vice versa. This follows from the constraint (2a), and is easily seen in (16). If $U_{12} = U_{21} > 0$, an increase in c increases the marginal utility of w . Consequently, there will be a tendency to increase w , which will counteract the increase in $\bar{c}$. If $U_{12} = U_{21} < 0$, the tendency to increase $\bar{c}$ will be strengthened instead. The fifth term shows that $\bar{c}$ will increase less, the quicker the marginal utility of money decreases as w increases. (When c is increased, and consequently w decreased, the marginal utility of the latter increases rapidly.) Finally, the sixth term concerns the amount of labour employed. When c increases and w decreases, the amount of labour will increase. (Cf. (3) and (14).) When L increases it will become more profitable to invest in the public safety good c . This term will reinforce the tendency to increase $\bar{c}$. (It is negative and thus lowers the value of the denominator.)

Now we turn to the numerator. We see that the effect of dA in isolation is clear. $dA < 0$ then gives $d\bar{c} < 0$. However the effect of an increase in the payroll tax is ambiguous. On the one hand, it increases the attractiveness of giving employees the desired utility through c , rather than through (taxable) w . This tendency to increase $\bar{c}$ is represented by the first term before dT . At the same time, an increase in T will lower the amount of labour employed. (Cf. (3) and (14).) This will tend to lower $\bar{c}$, since it becomes less attractive to invest in public goods. Thus we see that the method chosen to finance

these Social Insurances has a separate impact on the WE.⁶

Our main interest here, however, is the effect of a simultaneous decrease in A and increase in T. From (17a) it is obvious that $\bar{c}$ will decrease as long as

$$(18a) \quad y_1 dA - \frac{U_2}{U_1} \frac{(1+T)}{(1-t)} \frac{\bar{w}}{F_{11}} dT > \frac{U_2}{U_1} \frac{1}{(1-t)} \bar{L} dT.$$

By solving for U_2/U_1 in (4) and (5), and dividing by $p(-dA)$ which is positive, it is found that (18a) is equivalent to

$$(18b) \quad \frac{-y_1}{p} \left[1 + A \left(\frac{\bar{w}}{LF_{11}} + \frac{1}{(1+T)} \right) \frac{dT}{-dA} \right] > \left(\frac{\bar{w}}{LF_{11}} + \frac{1}{(1+T)} \right) \frac{dT}{-dA}.$$

To isolate $-y_1/p$, which is our objective, we must consider the sign of

$$\left(\frac{\bar{w}}{LF_{11}} + \frac{1}{(1+T)} \right).$$

Assume first that we have

$$\left(\frac{\bar{w}}{LF_{11}} + \frac{1}{(1+T)} \right) > 0.$$

Then (18b) is equivalent to

$$(18c) \quad \frac{-y_1}{p} > \frac{\left(\frac{\bar{w}}{LF_{11}} + \frac{1}{(1+T)} \right)}{\left[1 + A \left(\frac{\bar{w}}{LF_{11}} + \frac{1}{(1+T)} \right) \frac{dT}{-dA} \right]} \frac{dT}{-dA}$$

(We will return to this case shortly.)

Now assume that

$$\left(\frac{\bar{w}}{LF_{11}} + \frac{1}{(1+T)} \right) < 0, \text{ but at the same time}$$

$$\left[1 + A \left(\frac{\bar{w}}{LF_{11}} + \frac{1}{(1+T)} \right) \frac{dT}{-dA} \right] > 0.$$

Then (18b) is again equivalent to (18c), but this time the condition is necessarily fulfilled. This follows since the right-hand-side is now smaller than zero. (A similar result ensues if $[.] = 0.$)

Finally, consider the case where

$$\left(\frac{\bar{w}}{LF_{11}} + \frac{1}{(1+T)}\right) < 0, \text{ and}$$

$$\left[1 + A\left(\frac{\bar{w}}{LF_{11}} + \frac{1}{(1+T)}\right) \frac{dT}{-dA}\right] < 0.$$

Then (18b) transforms to

$$(18d) \quad \frac{-y_1}{p} < \frac{\left(\frac{\bar{w}}{LF_{11}} + \frac{1}{(1+T)}\right) \frac{dT}{-dA}}{\left[1 + A\left(\frac{\bar{w}}{LF_{11}} + \frac{1}{(1+T)}\right) \frac{dT}{-dA}\right]}$$

Here the right-hand-side is greater than $1/A$. From (4) and (5) it can easily be shown that we must have $-y_1/p < 1/A$. Therefore, (18d) is always fulfilled. Of these three cases, this leaves us with (18c) under the assumption that

$$\left(\frac{\bar{w}}{LF_{11}} + \frac{1}{(1+T)}\right) > 0$$

for further consideration. Set

$$\alpha = \left(\frac{\bar{w}}{LF_{11}} + \frac{1}{(1+T)}\right) \frac{dT}{-dA} > 0,$$

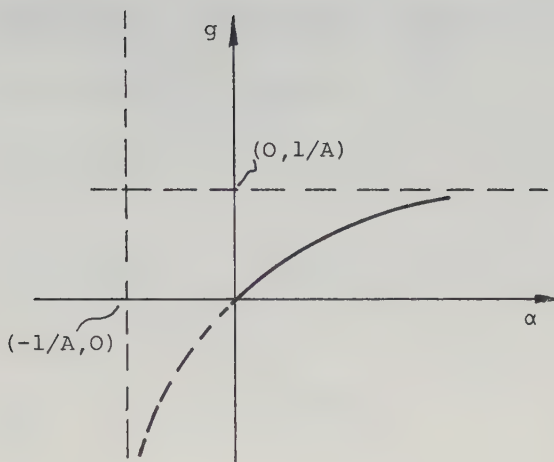
and

$$g(\alpha) = \frac{\alpha}{1 + A\alpha}.$$

Then (18c) can be written

$$(18e) \quad \frac{-y_1}{p} > g(\alpha).$$

Here $g(\alpha)$ is strictly increasing in α , viz.:



Thus, (18c) will be fulfilled if

$$(18f) \quad \frac{-y_1}{p} > \frac{\frac{1}{(1+T)}}{1 + A \frac{1}{(1+T)} \frac{dT}{-dA}} \frac{dT}{-dA}$$

This will be a good approximation of (18c) if $\bar{w}/LF_{11}$ is small. We will not hypothesize on this point. Now we write (18f) instead

$$(18g) \quad \frac{-y_1}{p} > \frac{1}{(1+T) + A \frac{dT}{-dA}} \frac{dT}{-dA}.$$

Obviously, (18g) will be fulfilled if

$$(18h) \quad \frac{-y_1}{p} > \frac{1}{(1+T)} \frac{dT}{-dA}.$$

The right-hand-side of (18h) is a good approximation of the right-hand-side of (18g) if

$$(1+T) \gg A \frac{dT}{-dA}.$$

This is probably not the case. Firstly, we have

$$(1+T) \approx 1.3.$$

Secondly, taking "hours of work" as our unit, what is the size of A?

A minimum value for A is obtained by considering only those direct costs that are taken off the company by the Social Insurance system. An average injury leads to 21 sick days. Assuming an hourly wage of 50 SEK, and an eight hour working day, we get (on average)

$$A > 21 \times 50 \times 8.$$

Now to $dT/-dA$. For the whole economy in aggregate we have (change in net expenditure for all companies in the aggregate equals zero)

$$-y \, dA = Lw \, dT$$

$$\langle \Rightarrow \rangle$$

$$\frac{dT}{-dA} = \frac{y}{Lw}.$$

for 1981 we then get⁷

$$\frac{dT}{-dA} = \frac{y}{Lw} = \frac{97,981 \times 21 \times 8}{5,170,955,000 \times 50}.$$

On average, we then obtain (using the minimum value for A)

$$A \frac{dT}{-dA} \approx 0.5.$$

A reasonable assumption would appear to be that the additional direct accident costs lies between zero and the cost incurred by the Social Insurance system. Then A could be up to twice as large as in the above calculation. This implies that $A(dT/-dA)$ lies between 0.5 and 1.

Thus it appears that in going from (18g) to (18h), we may have made our condition as much as twice as strong. In other words, if it can be hypothesized that (18h) is fulfilled, the argument for (18g) being fulfilled would be that much more compelling.⁸

Henceforth, we will use a simpler method to derive our condition. However, it should be remembered that the condition obtained for prevention to decrease (because of the existence of the Social Insurance system) may be considerably more demanding than the true one. Notably, similar considerations as in the discussion of expressions (18b)-(18h) also apply in these later cases.

Condition (18a) will necessarily be fulfilled if

$$(19a) \quad y_1 dA > \frac{U_2}{U_1} \frac{1}{(1-t)} \bar{L} dT.$$

From the identities corresponding to (4) and (5) we obtain

$$(20) \quad -p - Ay_1 + \frac{U_2}{U_1} \frac{(1+T)}{(1-t)} \bar{L} = 0.$$

Dividing this by p we get

$$(21) \quad 1 + \frac{1}{p} Ay_1 = \frac{1}{p} \frac{U_2}{U_1} \frac{(1+T)}{(1-t)} \bar{L}.$$

As $(1/p)Ay_1 < 0$, the right-hand-side here must be smaller than one.

Dividing (19a) by p we get the condition

$$(22) \quad \frac{1}{p} y_1 dA > \left[\frac{1}{p} \frac{U_2}{U_1} \frac{1}{(1-t)} \bar{L} \right] dT$$

From (21) it is obvious that the bracketed expression before dT (multiplied by $(1+T)$) is smaller than one. Therefore (22) will be fulfilled if

$$(23a) \quad \frac{1}{p} y_1 dA > \frac{1}{(1+T)} dT$$

$\langle \Rightarrow \rangle$

$$(24) \quad \frac{y_1}{p} < \frac{1}{(1+T)} \frac{dT}{dA}$$

$\langle \Rightarrow \rangle$

$$(25) \quad \frac{-y_1}{p} > \frac{1}{(1+T)} \frac{dT}{-dA}$$

Here $-y_1$ is the marginal reduction in labour lost (=labour gained) that follows from one unit of c . $-y_1/p$ is then the marginal reduction in labour lost due to one unit of expenditure on c . In the present context we can treat p as the absolute price of units of c .⁹

As we saw above, we have on average for the whole economy

$$(26a) \quad -y \, dA = Lw \, dT$$

$$\langle \Rightarrow \rangle$$

$$\frac{dT}{-dA} = \frac{y}{Lw}$$

Assuming again an hourly wage rate of 50 SEK, and an eight hour working day, we get (for 1981)

$$(27) \quad \frac{1}{(1+T)} \frac{dT}{-dA} = \frac{1}{(1+T)} \frac{y}{Lw} = \frac{1}{1.3} \frac{97,871 \times 21 \times 8}{5,170,955,000 \times 50}$$

This is a measure of the amount of labour that must be saved from one unit of expenditure on c.

Taking the inverse of this we get instead the maximum cost for reducing the amount of labour lost by one unit. Looking at the average accident (multiplying by 21 x 8), we find that it must not cost more than

$$1.3 \frac{5,170,955,000 \times 50}{97,871} \approx 3,430,000$$

to prevent it. In other words, company expenditure on prevention (c) will decrease as long as the cost of preventing the average accident is less than 3.4 million SEK. I suggest that this will generally be the case.

Now, expression (26a) above was an average for the whole economy. For firms in high-risk industries, we will have instead

$$(26b) \quad -y \, dA > Lw \, dT.$$

The companies pay less than "their share" of the injury costs. The necessary amount of labour saved by one unit of expenditure is then less than previously. It is even more probable that prevention will decrease.

How about companies in low-risk industries then? For them, a typical injury must cost less to prevent, if prevention shall decrease. The question is how much less? The calculations in Appendix 2 suggest that

for the lowest-risk industry we have

$$(26c) \quad -y \, dA \frac{0.70}{0.05} = Lw \, dT.$$

If injuries in low-risk firms were of the same severity as the country average, this implies that the maximum prevention cost for prevention to decrease is 14 times smaller. This amounts to 245,000 SEK. Once again, I suggest that this condition will normally be fulfilled. Of course, this does not mean that there may not be some firms where prevention does not increase. Note, however, that, as shown above, the simplifications made "under way" have all served to diminish the effects of the insurance system.

Thus we conclude that the existence of the Social Insurance system can be expected to decrease accident prevention in practically all companies (in this model, given by (1a) and (2a)).

We have also seen that a payroll tax has an ambiguous influence. It makes it more profitable to increase c , thereby enabling the firm to reduce w . On the other hand, the ensuing decrease in L makes it less profitable to invest in a local public good such as c .

The existence of the personal income tax, t , finally, will probably increase prevention.¹⁰ Using (7)-(10) with $dp = dA = dT = 0$ we get

$$(28a) \quad d\bar{c} = \frac{[-\bar{\lambda}U_2 \frac{1}{(1-t)} + \frac{U_2}{U_1} [\frac{(1+T)}{(1-t)}]^2 \frac{\bar{w}}{F_{11}}]dt}{Q}$$

where Q is the same denominator as in (17a). It is now profitable to attain the desired level of employee utility with a larger c , and correspondingly lower w . This is represented by the first term in the numerator. As with the payroll tax, labour has now become more expensive. The ensuing decrease in L makes it less worth while to invest in public WE goods. This explains the negative influence on $\bar{c}$, represented by the second term. It seems a priori plausible that the first effect will in practice be the larger one.

CASE B

This is a convenient place to look at the simple version of the problem used in Chapter 2. There we had

$$(1b) \quad P = F(L) - Lw - pc - Ay.$$

In addition, we implicitly assumed L and w to be constants, and consequently also ignored the constraint $U = U^0$. The problem is then to maximize P with respect to c . We studied the effect of a decrease in A . Differentiation of the first-order necessary condition for maximum gives us

$$(17b) \quad d\bar{c} = \frac{-y_1 dA}{Ay_{11}}.$$

Thus a decrease in A unambiguously leads to a lower prevention level in this case.

CASE C

So far we have studied public WE goods. Now we shall analyze the case of private safety goods. The interesting thing to investigate is then how the prevention activity per employee is affected. (Total prevention is given as this amount multiplied by the number of employees. It consequently depends to a large extent on the size of L .) We therefore define two new variables: c^* as units of injury prevention per amount of labour employed (c/L), and y^* as the amount of labour lost per amount of labour employed (y/L).

The problem for the firm now is to maximize

$$(1c) \quad P = F(L) - Lw(1+T) - pLc^* - ALy^*$$

with respect to L , w and c^* , and subject to the constraint

$$(2b) \quad U(w(1-t), c^*) = U^0.$$

With the same method as before, and $dp = dt = 0$, we get

$$(29) \quad d\bar{c}^* = \frac{[-\bar{L}y_1^* + \frac{y}{F_{11}}(-p - Ay_1^* + \frac{U_2}{U_1} \frac{(1+T)}{(1-t)})]dA}{R} + \\ + \frac{[\frac{U_2}{U_1} \frac{1}{(1-t)} \bar{L} + \frac{\bar{w}}{F_{11}}(-p - Ay_1^* + \frac{U_2}{U_1} \frac{(1+T)}{(1-t)})]dT}{R}$$

where¹²

$$(30) \quad R = \bar{L}Ay_{11}^* + \bar{\lambda}U_{22} - \bar{\lambda} \frac{U_2}{U_1} U_{12} - \bar{\lambda} \frac{U_2}{U_1} U_{21} + \bar{\lambda}(\frac{U_2}{U_1})^2 U_{11} > 0,$$

the sign of R following from fulfilment of the second-order sufficient condition.

From $Z_w = Z_c = 0$, one obtains for a maximum point

$$(31) \quad p + Ay_1^* = \frac{U_2}{U_1} \frac{(1+T)}{(1-t)}.$$

Thus (29) reduces to

$$(17c) \quad d\bar{c}^* = \frac{-\bar{L}y_1^* dA + \frac{U_2}{U_1} \frac{1}{(1-t)} \bar{L}dT}{R}.$$

As expected, an increase in T unambiguously raises the amount of private safety goods. (The effect of T on L is of no importance in this case.) A decrease in A lowers $\bar{c}^*$. What is the effect of the Social Insurance system (an increase in T coupled with a decrease in A)? In other words, do we have

$$(19b) \quad \bar{L}y_1^* dA > \frac{U_2}{U_1} \frac{1}{(1-t)} \bar{L}dT?$$

Dividing by $\bar{L}p$, and utilizing again the identities corresponding to Z_w and Z_c in the same way as before, this reduces to

$$(23b) \quad \frac{1}{p} y_1^* dA > \frac{1}{(1+T)} dT?$$

This is precisely equivalent to (23a), and the ensuing analysis is the same. Hence we conclude that the existence of the Social Insurance

system lowers the amount of private safety goods in practically all companies.

The personal income tax now unambiguously raises the level of prevention activities. We now obtain

$$(28b) \quad d\bar{c}^* = \frac{-\bar{\lambda} U_2 \frac{1}{(1-t)} dt}{R}.$$

CASE D

It is now time to return to the problem as formulated at the beginning of the appendix. Once again commencing with the case of a public safety good, the problem for the company is to maximize

$$(1d) \quad P = F(L-y, y) - (L-y)w(1+T) - pc - Ay$$

with respect to L , w and c , and subject to the constraint

$$(2a) \quad U(w(1-t), c) = U^0.$$

Following the usual procedure, we get¹³

$$(17d) \quad d\bar{c} = \frac{-y_1 dA + \left[\frac{U_2}{U_1} \frac{1}{(1-t)} (\bar{L}-y) + y_1 \frac{F_{21}}{F_{11}} \bar{w} + \frac{U_2}{U_1} \frac{(1+T)}{(1-t)} \frac{\bar{w}}{F_{11}} \right] dT}{S}$$

where

$$(32) \quad S = Ay_{11} + \bar{\lambda} U_{22} - \bar{\lambda} \frac{U_2}{U_1} U_{12} - \bar{\lambda} \frac{U_2}{U_1} U_{21} + \bar{\lambda} \left(\frac{U_2}{U_1} \right)^2 U_{11} + \\ + \left(\frac{U_2}{U_1} \right)^2 \left[\frac{(1+T)}{(1-t)} \right]^2 \frac{1}{F_{11}} - y_1^2 F_{22} - y_{11} F_2 + y_1^2 \frac{F_{12} F_{21}}{F_{11}} + \\ + \frac{U_2}{U_1} \frac{(1+T)}{(1-t)} y_1 \frac{F_{12}}{F_{11}} + \frac{U_2}{U_1} \frac{(1+T)}{(1-t)} y_1 \frac{F_{21}}{F_{11}}.$$

Once again, fulfilment of the second-order condition ensures that S is positive. The increase in T has an ambiguous effect on $\bar{c}$, as in the previous case where we studied a collective good. To study if the total effect of changes in A and T is to decrease $\bar{c}$, we note first that the latter two terms in front of dT tend to decrease $\bar{c}$. Thus, a sufficient condition for $\bar{c}$ to decrease is that

$$(19c) \quad y_1 dA > \frac{U_2}{U_1} \frac{1}{(1-t)} (\bar{L}-y) dT.$$

In the present problem, we have

$$(33) \quad Z_L = F_1 - \bar{w}(1+T) \equiv 0$$

$$(34) \quad Z_W = -(\bar{L}-y)(1+T) - \bar{\lambda}U_1(1-t) \equiv 0$$

$$(35) \quad Z_C = -F_1y_1 + F_2y_1 + \bar{w}(1+T)y_1 - p - Ay_1 - \bar{\lambda}U_2 \equiv 0.$$

We can use $Z_L = 0$ to simplify expression (35):

$$(36) \quad Z_C = F_2y_1 - p - Ay_1 - \bar{\lambda}U_2 = 0.$$

Solving (34) for $\bar{\lambda}$, and substituting into (36), we obtain

$$(37) \quad p + Ay_1 = F_2y_1 + \frac{U_2}{U_1} \frac{(1+T)}{(1-t)} (\bar{L}-y).$$

Noting that $Ay_1 < 0$ and $F_2y_1 > 0$, and dividing (19c) and (37) by p , it becomes clear that (19c) will certainly be fulfilled if

$$(23a) \quad \frac{1}{p} y_1 dA > \frac{1}{(1+T)} dT.$$

This is the same condition as before.¹⁴

The personal income tax has an ambiguous effect on $\bar{c}$, as before with collective safety goods:

$$(28c) \quad d\bar{c} = \frac{[-\bar{\lambda}U_2 \frac{1}{(1-t)} + \frac{(1+T)}{(1-t)} y_1 \frac{F_{21}}{F_{11}} \bar{w} + \frac{U_2}{U_1} [\frac{(1+T)}{(1-t)}]^2 \frac{\bar{w}}{F_{11}}] dt}{S}.$$

CASE E

We turn again to the case of private safety goods. The company then seeks to maximize

$$(1e) \quad P = F(L-Ly^*, Ly^*) - (L-Ly^*)w(1+T) - pLc^* - ALy^*$$

with respect to L , w and c^* , and subject to the constraint

$$(2b) \quad U(w(1-t), c^*) = U^0.$$

It will now be assumed that $F_{12} = F_{21} = 0$, which is quite acceptable as argued at the beginning of the appendix. Furthermore, we will assume that $F_{22} = 0$. This appears reasonable, as no strong a priori case can be made for a definite sign of F_{22} . With these assumptions, we get¹⁵

$$(17e) \quad d\bar{c}^* = \frac{-\bar{L}y_1^* \frac{1}{(1-y^*)} dA + \frac{U_2}{U_1} \frac{1}{(1-t)} \bar{L}(1-y^*) dT}{V}.$$

As before, the second-order sufficient condition ensures that V is positive. Thus, the condition for prevention to decrease is

$$(19d) \quad \bar{L}y_1^* \frac{1}{(1-y^*)} dA > \frac{U_2}{U_1} \frac{1}{(1-t)} \bar{L}(1-y^*) dT.$$

From the first-order conditions we have

$$(38) \quad \frac{1}{p} [-F_1 y_1^* + F_2 y_1^* + (1+T)[\bar{w}y_1 + \frac{U_2}{U_1} \frac{1}{(1-t)} (1-y^*)]] = 1 + \frac{1}{p} Ay_1^*.$$

We see that

$$(39) \quad \frac{1}{p} (1+T)[\bar{w}y_1^* + \frac{U_2}{U_1} \frac{1}{(1-t)} (1-y^*)] < 1.$$

If we now divide (19d) by $p\bar{L}$, and add $(1/p)(\bar{w}y_1^* - \bar{w}y_1^*)dT$ to the right-hand side, it is seen that (19d) will necessarily be fulfilled if

$$(40) \quad \frac{1}{p} y_1^* \frac{1}{(1-y^*)} dA > [\frac{1}{(1+T)} - \frac{1}{p} \bar{w}y_1^*] dT$$

$\Leftrightarrow$

$$(41) \quad \frac{-y_1^*}{p} \frac{1}{(1-y^*)} > \left[\frac{1}{(1+T)} - \frac{1}{p} \bar{w} y_1^* \right] \frac{dT}{-dA}.$$

Now, for the whole economy on average, we have

$$(42) \quad -Ly^* dA = L(1-y^*)w dT$$

$\langle \Rightarrow \rangle$

$$(43) \quad \frac{dT}{-dA} = \frac{y^*}{(1-y^*)w}.$$

To account for high- and low-risk industries, we introduce a factor k , and get

$$(44) \quad \frac{dT}{-dA} = \frac{ky^*}{(1-y^*)w}.$$

k is smaller than one for high-risk industries, and greater than one for low-risk industries. Using (44), we can now write (41)

$$(45) \quad \frac{-y_1^*}{p} > \frac{ky^*}{w} \left[\frac{1}{(1+T)} - \frac{1}{p} \bar{w} y_1^* \right].$$

Rearranging, we get

$$(46) \quad \frac{-y_1^*}{p} > \frac{y^*}{\left(\frac{1}{k} - y^*\right)\bar{w}(1+T)}.$$

Using the same figures as before, we get the minimum amount of labour that must be saved from injury by one unit of expenditure on c (for $k = 1$)

$$\frac{y^*}{\left(\frac{1}{k} - y^*\right)\bar{w}(1+T)} = \frac{\frac{97.871 \times 21 \times 8}{5,170,955,000}}{\left(1 - \frac{97.871 \times 21 \times 8}{5,170,955,000}\right) \times 50 \times 1.3}.$$

Once again, we can transform this to the maximum allowed cost for the prevention of a typical accident (taking the inverse, and multiplying by 21×8). This amounts to 3,420,000 SEK. In high-risk industries, the maximum allowable cost is higher. In low-risk industries it is lower, but still in the magnitude of ($k = 14$) 245,000 SEK. Thus, prevention prevention may be expected to decrease.

With respect to the personal income tax we obtain

$$(28d) \quad d\bar{c}^* = \frac{-\bar{\lambda} U_2 \frac{1}{(1-t)} dt}{V}.$$

The personal income tax (like the payroll tax) raises the level of safety.

CASE F

We will now take a brief look at the effects of taxation on the provision of WE quality other than injury prevention. (The analysis is obviously applicable to any similar non-taxed employment benefit.) The firm is first assumed to maximize

$$(1f) \quad P = F(L) - Lw(1+T) - pB$$

with respect to L , w and B , and subject to the constraint

$$(2c) \quad U(w(1-t), B) = U^0.$$

Thus, B is here a (local) public good. p is now the (relative) price of one unit of B . With the usual procedure, we get

$$(47a) \quad d\bar{B} = \frac{\left[\frac{U_2}{U_1} \frac{1}{(1-t)} \bar{L} + \frac{U_2}{U_1} \frac{(1+T)}{(1-t)} \frac{\bar{w}}{F_{11}} \right] dT}{W} +$$

$$+ \frac{\left[-\bar{\lambda} U_2 \frac{1}{(1-t)} + \left(\frac{U_2}{U_1} \right)^2 \left[\frac{(1+T)}{(1-t)} \right]^2 \frac{1}{F_{11}} \right] dt}{W}.$$

Both taxes have an ambiguous effect on the supply of B , since they affect L and thus the profitability of investing in a public good. (W is positive.)

CASE G

The provision per labour employed of a private WE good, B^* , is determined as the company maximizes

$$(1g) \quad P = F(L) - Lw(1+T) - pLB^*$$

with respect to L , w and B^* , and subject to the constraint

$$(2d) \quad U(w(1-t), B^*) = U^0.$$

One obtains

$$(47b) \quad dB^* = \frac{\left[\frac{U_2}{U_1} \frac{1}{(1-t)} \bar{L} \right] dT + \left[-\bar{\lambda} U_2 \frac{1}{(1-t)} \right] dt}{W'}.$$

Both taxes have a positive effect on the provision of WE quality in the nature of private goods (W' being positive).

CASE H

Until now, we have assumed that the firm tries to maximize its profits. In the final part of this appendix we will study the case of a cost-minimizing company. (Minimizing the cost of a given production volume.) The presentation follows the same scheme as for the profit-maximizing firm. Corresponding to (1a), the problem now is to minimize the total costs, TC ,

$$(48a) \quad TC = Lw(1+T) + pc + Ay$$

with respect to L , w and c , and subject to the constraints

$$(2a) \quad U(w(1-t), c) = U^0,$$

$$(49a) \quad F(L) = F^0.$$

Note that (49a) implies that L is fixed. Thus, one obtains

$$(17f) \quad d\bar{c} = \frac{y_1 dA - \frac{U_2}{U_1} \frac{1}{(1-t)} \bar{L} dT}{X},$$

$$(28e) \quad d\bar{c} = \frac{-\bar{\lambda} U_2 \frac{1}{(1-t)} dt}{X}$$

where X is negative (from the second-order condition). Note that $\bar{\lambda}$ now is positive. The numerator equals the solution (17a) and (28a) without the terms due to the change in L that occurred in Case A. The condition for the existence of the Social Insurance system to reduce prevention is identical to (19a).

In the simple case presented by (1b), cost minimizing yields an identical result.

CASE I

We now study the problem to minimize

$$(48b) \quad TC = Lw(1+T) + pLc^* + ALy^*$$

with respect to L , w and c^* , and subject to the constraints

$$(2b) \quad U(w(1-t), c^*) = U^0,$$

$$(49a) \quad F(L) = F^0.$$

This corresponds to (1c). Once again L is fixed. One obtains

$$(17g) \quad d\bar{c}^* = \frac{\bar{L} y_1^* dA - \frac{U_2}{U_1} \frac{1}{(1-t)} \bar{L} dT}{Y},$$

$$(28f) \quad d\bar{c}^* = \frac{-\bar{\lambda} U_2 \frac{1}{(1-t)} dt}{Y}$$

where Y is negative. This corresponds exactly to the solution in Case C (see (17c) and (28b)).

CASE J

The more complex versions corresponding to Cases D and E (cf. (1d) and (1e)) also give results highly similar to the case of profit maximization. We begin with a firm that tries to minimize

$$(48c) \quad TC = (L-y)w(1+T) + pc + Ay$$

with respect to L , w and c , and subject to the constraints

$$(2a) \quad U(w(1-t), c) = U^0,$$

$$(49b) \quad F(L-y, y) = F^0.$$

Now L is no longer fixed, since it can be substituted by c in the production function. Here the necessary first-order conditions become

$$(50) \quad Z_L = w(1+T) - \gamma F_1 = 0$$

$$(51) \quad Z_w = (L-y)(1+T) - \lambda U_1(1-t) = 0$$

$$(52) \quad Z_c = -w(1+T)y_1 + p + Ay_1 - \lambda U_2 + \gamma F_1 y_1 - \gamma F_2 y_1 = 0$$

$$(53) \quad Z_\lambda = U^0 - U(w(1-t), c) = 0$$

$$(54) \quad Z_\gamma = F^0 - F(L-y, y) = 0.$$

With the same procedure as before, we find

$$(17h) \quad d\bar{c} = \frac{y_1 dA + \left[-\frac{U_2}{U_1} \frac{1}{(1-t)} (\bar{L}-y) - y_1 \frac{F_2}{F_1} \bar{w} + y_1 \bar{w} \right] dT}{M}$$

where M is negative (from the sufficient second-order condition¹⁶). The existence of the Social Insurance system will decrease prevention if

$$(19e) \quad y_1 dA > \left[\frac{U_2}{U_1} \frac{1}{(1-t)} (\bar{L}-y) + y_1 \frac{F_2}{F_1} \bar{w} - y_1 \bar{w} \right] dT.$$

Using (50) and (51) we can write expression (52)

$$(55) \quad 1 + \frac{1}{p} A y_1 = (1+T) \left[\frac{1}{p} \frac{U_2}{U_1} \frac{1}{(1-t)} (L-y) + \frac{1}{p} y_1 \frac{F_2}{F_1} w \right].$$

It is thus seen that the value of the right-hand-side is less than one. Consequently, (19e) will be fulfilled if

$$(56) \quad \frac{1}{p} y_1 dA > \left[\frac{1}{(1+T)} - \frac{1}{p} y_1 \bar{w} \right] dT.$$

This leads us, mutatis mutandis, back to a condition similar to 46.¹⁷

For the personal income tax, we have here

$$(28g) \quad d\bar{c} = \frac{\left[-\bar{\lambda} U_2 \frac{1}{(1-t)} - y_1 \frac{F_2}{F_1} \bar{w} \frac{(1+T)}{(1-t)} \right] dt}{M}.$$

In relation to Case D there is an additional positive influence on $\bar{c}$ from both taxes. (Cf. (17d) and (28c).) This stems from the fact that an increase in c enables the firm to lower L .

CASE K

Finally, we examine the problem to minimize

$$(48d) \quad TC = (L - Ly^*)w(1+T) + pLc^* + ALy^*$$

with respect to L , w and c^* , and subject to the constraints

$$(2b) \quad U(w(1-t), c^*) = U^0,$$

$$(49c) \quad F(L - Ly^*, Ly^*) = F^0.$$

Here the first order conditions are

$$(57) \quad Z_L = (1-y^*)w(1+T) + pc^* + Ay^* - \gamma F_1(1-y^*) - \gamma F_2 y^* = 0$$

$$(58) \quad Z_w = L(1-y^*)(1+T) - \lambda U_1(1-t) = 0$$

$$(59) \quad Z_C = -Lw(1+T)y_1^* + pL + ALy_1^* - \lambda U_2 + \gamma F_1 Ly_1^* - \gamma F_2 Ly_1^* = 0$$

$$(60) \quad Z_\lambda = U^0 - U(w(1-t), c^*) = 0$$

$$(61) \quad Z_\gamma = F^0 - F(L-Ly^*, Ly^*) = 0.$$

Total differentiation of (61) yields

$$(62) \quad -F_1(1-y^*)dL - F_2y^*dL + F_1Ly_1^*dc - F_2Ly_1^*dc = 0$$

$\langle = \rangle$

$$(63) \quad [F_1(1-y^*) + F_2y^*]dL = [F_1Ly_1^* - F_2Ly_1^*]dc.$$

We will assume that

$$(64) \quad F_1(1-y^*) + F_2y^* > 0.$$

In other words, that an increase in L increases production. This seems appropriate. We are now ready to look at the results for this case. We have

$$(17i) \quad d\bar{c}^* = \frac{\frac{F_1 \bar{L}y_1^*}{F_1(1-y^*) + F_2y^*} dA}{N} +$$

$$+ \frac{\left[-\frac{U_2}{U_1} \frac{1}{(1-t)} \bar{L}(1-y^*) - \frac{F_2 \bar{L}y_1^* \bar{w}}{F_1(1-y^*) + F_2y^*} \right] dT}{N},$$

$$(28h) \quad d\bar{c}^* = \frac{\left[-\bar{\lambda}U_2 \frac{1}{(1-t)} - \left(\frac{F_2 \bar{L}y_1^* \bar{w}}{F_1(1-y^*) + F_2y^*} \right) \left(\frac{(1+T)}{(1-t)} \right) \right] dt}{N},$$

where N is negative. As in the previous case, there is in comparison with profit maximization an additional positive influence on $\bar{c}^*$ of the taxes. Will the Social Insurance system decrease prevention? For this to be the case, we must have

$$(19f) \quad \frac{\frac{F_1 \bar{L}y_1^*}{F_1(1-y^*) + F_2y^*} dA}{N} > \left[\frac{U_2}{U_1} \frac{1}{(1-t)} \bar{L}(1-y^*) + \frac{F_2 \bar{L}y_1^* \bar{w}}{F_1(1-y^*) + F_2y^*} \right] dT.$$

We can write this

$$(65) \quad \frac{F_1 \bar{L} y_1^*}{K} dA > \left[\frac{U_2}{U_1} \frac{1}{(1-t)} \bar{L}(1-y^*) + \bar{L} y_1^* \bar{w} - (1-y^*) \bar{w} \frac{F_1 \bar{L} y_1^* - F_2 \bar{L} y_1^*}{K} \right] dT$$

where $K = F_1(1-y^*) + F_2 y^*$. From (57) we have

$$(66) \quad \gamma = \frac{(1-y^*)w(1+T) + pc^* + Ay^*}{K}.$$

Substituting for γ and λ (from (58)) in (59) we get (after dividing by pL)

$$(67) \quad 1 + \frac{1}{p} Ay_1^* = \frac{1}{p} \frac{U_2}{U_1} \frac{(1+T)}{(1-t)} (1-y^*) + \frac{1}{p} w(1+T)y_1^* - \frac{1}{p} (1-y^*)w(1+T) \frac{F_1 y_1^* - F_2 y_1^*}{K} - c^* \frac{F_1 y_1^* - F_2 y_1^*}{K} - \frac{1}{p} Ay^* \frac{F_1 y_1^* - F_2 y_1^*}{K}.$$

Noting that the last two terms on the right-hand-side are positive, one realizes that this implies

$$(68) \quad \frac{1}{p} \frac{U_2}{U_1} \frac{(1+T)}{(1-t)} (1-y^*) + \frac{1}{p} w(1+T)y_1^* - \frac{1}{p} (1-y^*)w(1+T) \frac{F_1 y_1^* - F_2 y_1^*}{K} < 1.$$

Therefore, (19f) will be fulfilled if

$$(69) \quad \frac{1}{p} \frac{F_1 y_1^*}{K} dA > \frac{1}{(1+T)} dT.$$

Since $F_1/K > 1$, we can use the familiar condition

$$(70) \quad \frac{1}{p} y_1^* dA > \frac{1}{(1+T)} dT.$$

This concludes our discussion of the cost-minimizing firm.

The results of the formal analysis are summarized in Table A1.1 (pp. 274-279). We may present these results and the quantifications above in a number of propositions:

I. FOR A PROFIT-MAXIMIZING FIRM

Proposition 1: The existence of the Social Insurance system induces companies to spend less on accident prevention (17a-e).

Proposition 2: An increase in the rate of the payroll tax will increase the provision of private safety goods and vice versa (17c,e). It has an ambiguous effect on the provision of public safety goods (17a,d). To the extent that an increase in the rate of the payroll tax does not affect the amount of labour employed, it will also increase the provision of public safety goods.

Proposition 3: An increase in the rate of the personal income tax will increase the provision of private safety goods and vice versa (28b,d). It has an ambiguous effect on the provision of public safety goods (28a,c). To the extent that an increase in the rate of the income tax does not affect the amount of labour employed, it will also increase the provision of public safety goods.

Proposition 4: The results in Propositions 3 and 4 apply, mutatis mutandis, to other kinds of WE quality (47a,b).

II. FOR A COST-MINIMIZING FIRM

Proposition 1': The existence of the Social Insurance system induces companies to spend less on accident prevention (17f-i).

Proposition 2': An increase in the rate of the payroll tax will increase the provision of both private and public safety goods, and vice versa (17f-i).

Proposition 3': An increase in the rate of the personal income tax will increase the provision of both private and public safety goods, and vice versa (28e-h).

Table A1.1: Effects of the Social Insurance system and taxation on the provision of WE quality by companies (explanation of symbols, see pp. 248, 260, and 266-267)

I. PROFIT MAXIMIZATION

CASE A

$$(1a) \quad P = F(L) - Lw(1+T) - pc - Ay$$

$$(2a) \quad U(w(1-t), c) = U^0$$

$$dp = dt = 0$$

$$(17a) \quad d\bar{c} = \frac{-y_1 dA + \left[\frac{U_2}{U_1} \frac{1}{(1-t)} \bar{L} + \frac{U_2}{U_1} \frac{(1+T)}{(1-t)} \frac{\bar{w}}{F_{11}} \right] dT}{Q}$$

$$dp = dA = dT = 0$$

$$(28a) \quad d\bar{c} = \frac{\left[-\bar{\lambda} U_2 \frac{1}{(1-t)} + \frac{U_2}{U_1} \left[\frac{(1+T)}{(1-t)} \right]^2 \frac{\bar{w}}{F_{11}} \right] dt}{Q}$$

CASE B

$$(1b) \quad P = F(L) - Lw - pc - Ay$$

L and w constants

$$(17b) \quad d\bar{c} = \frac{-y_1 dA}{Ay_{11}}$$

CASE C

$$(1c) \quad P = F(L) - Lw(1+T) - pLc^* - ALy^*$$

$$(2b) \quad U(w(1-t), c^*) = U^0$$

Case C cont.

$$dp = dt = 0$$

$$(17c) \quad d\bar{c}^* = \frac{-\bar{L}y_1^* dA + \frac{U_2}{U_1} \frac{1}{(1-t)} \bar{L}dT}{R}$$

$$dp = dA = dT = 0$$

$$(28b) \quad d\bar{c}^* = \frac{-\bar{\lambda}U_2 \frac{1}{(1-t)} dt}{R}$$

CASE D

$$(1d) \quad P = F(L-y, y) - (L-y)w(1+T) - pc - Ay$$

$$(2a) \quad U(w(1-t), c) = U^0$$

$$dp = dt = 0$$

$$(17d) \quad d\bar{c} = \frac{-y_1 dA + \left[\frac{U_2}{U_1} \frac{1}{(1-t)} (\bar{L}-y) + y_1 \frac{F_{21}}{F_{11}} \bar{w} + \frac{U_2}{U_1} \frac{(1+T)}{(1-t)} \frac{\bar{w}}{F_{11}} \right] dT}{S}$$

$$dp = dA = dT = 0$$

$$(28c) \quad d\bar{c} = \frac{\left[-\bar{\lambda}U_2 \frac{1}{(1-t)} + \frac{(1+T)}{(1-t)} y_1 \frac{F_{21}}{F_{11}} \bar{w} + \frac{U_2}{U_1} \left[\frac{(1+T)}{(1-t)} \right]^2 \frac{\bar{w}}{F_{11}} \right] dt}{S}$$

CASE E

$$(1e) \quad P = F(L-Ly^*, Ly^*) - (L-Ly^*)w(1+T) - pLc^* - ALy^*$$

$$(2b) \quad U(w(1-t), c^*) = U^0$$

$$F_{12} = F_{21} = F_{22} = 0$$

Case E cont.

$$dp = dt = 0$$

$$(17e) \quad d\bar{c}^* = \frac{-\bar{L}y_1^* \frac{1}{(1-y^*)} dA + \frac{U_2}{U_1} \frac{1}{(1-t)} \bar{L}(1-y^*) dT}{V}$$

$$dp = dA = dT = 0$$

$$(28d) \quad d\bar{c}^* = \frac{-\bar{\lambda}U_2 \frac{1}{(1-t)} dt}{V}$$

CASE F

$$(1f) \quad P = F(L) - Lw(1+T) - pB$$

$$(2c) \quad U(w(1-t), B) = U^0$$

$$(47a) \quad d\bar{B} = \frac{\left[\frac{U_2}{U_1} \frac{1}{(1-t)} \bar{L} + \frac{U_2}{U_1} \frac{(1+T)}{(1-t)} \frac{\bar{w}}{F_{11}} \right] dT}{W} +$$

$$+ \frac{\left[-\bar{\lambda}U_2 \frac{1}{(1-t)} + \left(\frac{U_2}{U_1} \right)^2 \left[\frac{(1+T)}{(1-t)} \right]^2 \frac{1}{F_{11}} \right] dt}{W}$$

CASE G

$$(1g) \quad P = F(L) - Lw(1+T) - pLB^*$$

$$(2d) \quad U(w(1-t), B^*) = U^0$$

$$(47b) \quad d\bar{B}^* = \frac{\left[\frac{U_2}{U_1} \frac{1}{(1-t)} \bar{L} \right] dT + \left[-\bar{\lambda}U_2 \frac{1}{(1-t)} \right] dt}{W'}$$

Note: Q, R, S, V, W, and W' all positive.

II. COST MINIMIZATION

CASE H

$$(48a) \quad TC = Lw(1+T) + pc + Ay$$

$$(2a) \quad U(w(1-t), c) = U^0$$

$$(49a) \quad F(L) = F^0$$

$$dp = dt = 0$$

$$(17f) \quad d\bar{c} = \frac{y_1 dA - \frac{U_2}{U_1} \frac{1}{(1-t)} \bar{L} dT}{X}$$

$$dp = dA = dT = 0$$

$$(28e) \quad d\bar{c} = \frac{-\bar{\lambda} U_2 \frac{1}{(1-t)} dt}{X}$$

CASE I

$$(48b) \quad TC = Lw(1+T) + pLc^* + ALy^*$$

$$(2b) \quad U(w(1-t), c^*) = U^0$$

$$(49a) \quad F(L) = F^0$$

$$dp = dt = 0$$

$$(17g) \quad d\bar{c}^* = \frac{\bar{L} y_1^* dA - \frac{U_2}{U_1} \frac{1}{(1-t)} \bar{L} dT}{Y}$$

$$dp = dA = dT = 0$$

$$(28f) \quad d\bar{c}^* = \frac{-\bar{\lambda} U_2 \frac{1}{(1-t)} dt}{Y}$$

CASE J

$$(48c) \quad TC = (L-y)w(1+T) + pc + Ay$$

$$(2a) \quad U(w(1-t), c) = U^0$$

$$(49b) \quad F(L-y, y) = F^0$$

$$dp = dt = 0$$

$$(17h) \quad d\bar{c} = \frac{y_1 dA + \left[-\frac{U_2}{U_1} \frac{1}{(1-t)} (\bar{L}-y) - y_1 \frac{F_2}{F_1} \bar{w} + y_1 \bar{w} \right] dt}{M}$$

$$dp = dA = dT = 0$$

$$(28g) \quad d\bar{c} = \frac{\left[-\bar{L}U_2 \frac{1}{(1-t)} - y_1 \frac{F_2}{F_1} \bar{w} \frac{(1+T)}{(1-t)} \right] dt}{M}$$

CASE K

$$(48d) \quad TC = (L-Ly^*)w(1+T) + pLc^* + ALy^*$$

$$(2b) \quad U(w(1-t), c^*) = U^0$$

$$(49c) \quad F(L-Ly^*, Ly^*) = F^0$$

$$dp = dt = 0$$

$$(17i) \quad d\bar{c}^* = \frac{\frac{F_1 \bar{L}y_1^*}{F_1(1-y^*) + F_2 y^*} dA}{N} +$$

$$+ \frac{\left[-\frac{U_2}{U_1} \frac{1}{(1-t)} \bar{L}(1-y^*) - \frac{F_2 \bar{L}y_1^* \bar{w}}{F_1(1-y^*) + F_2 y^*} \right] dT}{N}$$

$$dp = dA = dT = 0$$

Case K cont.

$$(28h) \quad d\bar{c}^* = \frac{[-\bar{\lambda}U_2 \frac{1}{(1-t)} - (\frac{F_2 \bar{L}y_1^* \bar{w}}{F_1(1-y^*) + F_2 y^*}) (\frac{(1+T)}{(1-t)})] dt}{N}$$

Note: X, Y, M and N all negative.

Notes to Appendix 1

1. A more complex version of the expression for profits could take account of the possibility that the company pays a certain percentage of wages one or more days to injured persons. (This may for example ensue if there are waiting days in the compulsory Work Injury Insurance. This would complicate the analysis considerably. It will not be attempted here, as it is unlikely that it would add anything of major importance in relation to the issues discussed in this appendix.

2. The assumption $y_1 < 0$ implies that an increase in safety investments undertaken by the firm will not be totally offset by decreasing prevention on the part of the employees. On the other hand, the present formulation does not exclude the existence of such a countervailing tendency.

3. In terms of the bordered Hessian, the second-order sufficient condition for maximum in this case is

$$|\bar{H}_2| = \begin{vmatrix} 0 & 0 & U_1(1-t) \\ 0 & Z_{LL} & Z_{Lw} \\ U_1(1-t) & Z_{wL} & Z_{ww} \end{vmatrix} > 0$$

$$|\bar{H}_3| = \begin{vmatrix} 0 & 0 & U_1(1-t) & U_2 \\ 0 & Z_{LL} & Z_{Lw} & Z_{Lc} \\ U_1(1-t) & Z_{wL} & Z_{ww} & Z_{wc} \\ U_2 & Z_{cL} & Z_{cw} & Z_{cc} \end{vmatrix} < 0.$$

4. An alternative way of obtaining the result below is the following. The system of equations (7)-(10) can be written (for $dp = 0$)

$$\begin{bmatrix} Z_{\lambda\lambda} & Z_{\lambda L} & Z_{\lambda w} & Z_{\lambda c} \\ Z_{L\lambda} & Z_{LL} & Z_{Lw} & Z_{Lc} \\ Z_{w\lambda} & Z_{wL} & Z_{ww} & Z_{wc} \\ Z_{c\lambda} & Z_{cL} & Z_{cw} & Z_{cc} \end{bmatrix} \begin{bmatrix} d\bar{\lambda} \\ d\bar{L} \\ d\bar{w} \\ d\bar{c} \end{bmatrix} = \begin{bmatrix} 0 & + & 0 & - U_1 \bar{w} dt \\ 0 & + & \bar{w} dT & + 0 \\ 0 & + & \bar{L} dT & + [-\bar{\lambda}(1-t)U_{11}\bar{w} - \bar{\lambda}U_1]dt \\ y_1 dA & + & 0 & - \bar{\lambda}U_{21}\bar{w} dt \end{bmatrix}$$

By Cramer's rule, we then have (note $z_{\lambda\lambda} = z_{L\lambda} = z_{\lambda L} = 0$)

$$\frac{d\bar{c}}{dA} = \frac{1}{|J|} \begin{vmatrix} 0 & 0 & z_{\lambda w} & 0 \\ 0 & z_{LL} & z_{Lw} & 0 \\ z_{w\lambda} & z_{wL} & z_{ww} & 0 \\ z_{c\lambda} & z_{cL} & z_{cw} & y_1 \end{vmatrix},$$

$$\frac{d\bar{c}}{dT} = \frac{1}{|J|} \begin{vmatrix} 0 & 0 & z_{\lambda w} & 0 \\ 0 & z_{LL} & z_{Lw} & \bar{w} \\ z_{w\lambda} & z_{wL} & z_{ww} & \bar{L} \\ z_{c\lambda} & z_{cL} & z_{cw} & 0 \end{vmatrix} \quad \text{and}$$

$$\frac{d\bar{c}}{dt} = \frac{1}{|J|} \begin{vmatrix} 0 & 0 & z_{\lambda w} & -U_1 \bar{w} \\ 0 & z_{LL} & z_{Lw} & 0 \\ z_{w\lambda} & z_{wL} & z_{ww} & [-\bar{\lambda}(1-t)U_{11}\bar{w} - \bar{\lambda}U_1] \\ z_{c\lambda} & z_{cL} & z_{cw} & -\bar{\lambda}U_{21}\bar{w} \end{vmatrix}$$

where the Jacobian $|J|$ has the same value as the bordered Hessian $|\bar{H}|$. A similar procedure can be followed in the cases below.

5. This follows from $|\bar{H}_3| < 0$ (after dividing by $F_{11}(U_1)^2(1-t)^2 (<0)$).

6. Obviously, other methods of financing could have been chosen. For example, a tax on labour would only have tended to decrease safety investments (through its impact on the amount of labour). In that case one would have

$$P = F(L) - Lw(1+T) - LT_L - pc - Ay$$

where T_L is the tax on labour. We then get

$$d\bar{c} = \frac{-y_1 dA + \frac{U_2}{U_1} \frac{(1+T)}{(1-t)} \frac{1}{F_{11}} dT_L}{Q}$$

where Q is the same denominator as in (17a).

7. L and y are obtained from Occupational Injuries 1981, table 2.

8. Below we will calculate the maximum cost for the prevention of an accident, that is allowable for our conclusion (that prevention is decreased) to hold. This is obtained by taking the inverse of the right-hand-side of (18h), and multiplying by the amount of labour lost from one accident. In other words, we take

$$D < \frac{\frac{(1+T)}{dT}}{-dA} \times 21 \times 8,$$

where D is the maximum cost. Note that D here equals a maximum tolerable size for A ; the latter arising from the fact that (18h) must not clash with the fact that (from (4) and (5))

$$\frac{-y_1}{p} < \frac{1}{A}.$$

9. Conditions (19a) and (23a) would remain unchanged if we had included the product price in the expression for profits. The same is true for the corresponding conditions in the following cases.

10. It is easily shown that an increase in the price of safety, p , will lower c .

11. The same result would occur with a slightly more realistic version. If the problem is to maximize

$$P = F(L) - Lw - pc - Ay$$

with respect to w and c , and subject to the constraint

$$U(w, c) = U^0,$$

we get

$$d\bar{c} = \frac{-y_1 dA}{Ay_{11} + \bar{\lambda} U_{22} - \bar{\lambda} \frac{U_2}{U_1} U_{12} + \bar{\lambda} \left(\frac{U_2}{U_1}\right)^2 U_{11} - \bar{\lambda} \frac{U_2}{U_1} U_{21}}.$$

12. We use (31) (see below) to derive the expression for R .

13. Before the total differentiation, it is advisable to use the first-order condition $F_1 = w(1+T)$ to simplify the expression for Z_c . (Cf. below expression (36).)

14. Instead of (26a) we get

$$-y \, dA = (L-y)w \, dT.$$

However this is of negligible importance for the calculation.

15. Inter alia using the fact (from the expressions for z_w and z_c) that

$$-F_1 y_1^* + F_2 y_1^* + \bar{w}(1+T)y_1^* - p - Ay_1^* + \frac{U_2}{U_1} \frac{(1+T)}{(1-t)} (1-y_1^*) = 0.$$

16. In this case we get a Hessian with more than one border. For a minimum, as sufficient condition is that

$$|\bar{H}_2| = \begin{vmatrix} 0 & 0 & g_1^1 & g_2^1 \\ 0 & 0 & g_1^2 & g_2^2 \\ g_1^1 & g_1^2 & z_{LL} & z_{Lw} \\ g_2^1 & g_2^2 & z_{wL} & z_{ww} \end{vmatrix} > 0,$$

$$|\bar{H}_3| = \begin{vmatrix} 0 & 0 & g_1^1 & g_2^1 & g_3^1 \\ 0 & 0 & g_1^2 & g_2^2 & g_3^2 \\ g_1^1 & g_1^2 & z_{LL} & z_{Lw} & z_{Lc} \\ g_2^1 & g_2^2 & z_{wL} & z_{ww} & z_{wc} \\ g_3^1 & g_3^2 & z_{cL} & z_{cw} & z_{cc} \end{vmatrix} > 0,$$

where $g_1^1 = \frac{\partial U(w(1-t), c)}{\partial L}$, $g_2^1 = \frac{\partial U(\cdot)}{\partial w}$, $g_3^1 = \frac{\partial U(\cdot)}{\partial c}$, and

$$g_1^2 = \frac{\partial F(L-y, y)}{\partial L}, \quad g_2^2 = \frac{\partial F(\cdot)}{\partial w}, \quad g_3^2 = \frac{\partial F(\cdot)}{\partial c}.$$

17.

$$\frac{-y_1}{p} > \frac{\frac{y}{\bar{L}-y}}{\left(\frac{1}{k} - \frac{y}{\bar{L}-y}\right)\bar{w}(1+T)}.$$

**APPENDIX 2: COLLECTIVELY FINANCED EXPENDITURE RELATED TO VARIATIONS
IN OCCUPATIONAL SAFETY AND HEALTH: A CASE STUDY OF
DIFFERENTIATED INSURANCE PREMIUMS IN SWEDEN**

1. Introduction

The purpose here is to identify the part of the expenditure related to occupational safety and health that is canalized through public institutions. This expenditure is then distributed among all different branches of business/industry in the economy. All calculations are made for the year 1979.

We next calculate a branch specific payroll tax that would cover this expenditure. The reason for this way of expressing the different costs attributable to the activity is, of course, that today almost all of this expenditure is financed by uniform payroll taxes.

We are consequently not trying to estimate the "total social costs" associated with health and safety risks at the workplace. Rather, we are using an insurance approach, looking at the total amount of compensation paid to the disabled, the sick, etc., either as direct transfers or as indirect subsidies.

It should be pointed out that this exercise is more in the character of a numerical example. Consequently it should not be used directly in any kind of policy prescription.

2. Types of Expenditure Included in the Material

We have included the following kinds of expenditure: the expenditure of the Work Injury Insurance, d:o (part of) the Health Insurance, and expenditure for health care.

The reason for including the WII is obvious and need not be discussed.¹

The argument for including HI coverage for items that might be related to workdays lost through illness is more problematic. (This includes mainly medical care and cash sick benefits. Note that not all HI expenditures are included.) Obviously, a part of this expenditure varies between branches according to general differences in WE. This was discussed in section 2.3. Just as obvious, part of these costs are unrelated to these variations. However, this should not be a great problem, since our aim is to study the effect of differentiated as opposed to uniform payroll taxes.²

Expenditures on health care in excess of HI financing should obviously be included too.³ However, our data for these are less precise than the rest and we have to rely on rather crude approximations.

For the health care expenditure related to occupational injuries we use a study by Jonsson (1974a) who studied these costs for 1970. From his material, we calculated the health care expenditures as a percentage of production losses due to occupational injuries. This percentage is then used as a proxy for health care costs as percentage of: the HI expenditure related to occupational injuries plus the WII expenditure on cash sick benefits and such (items (2) and (3) in Table A2.1, p. 290).⁴ Thus a measure of health care costs related to occupational injuries is obtained.

However, by far the largest part of health care expenditure that we seek is the expenditure related to absence from work due to illness, excluding occupational injuries. Our point of departure here is an estimation of the costs of bed days at hospital. Using the average cost in 1976 (Lindgren, 1981), this figure is adjusted by a price index for health care services⁵ and multiplied by the number of bed days (those bed days which are also days of sickness cash benefits). Obviously, this is not the total cost for the health care related to absence from work. In this respect the resulting 3.1 billion⁶ (item (9) in Table A2.1) is an under-estimation. Because of this, we did not try to adjust for the double counting that is due to the fact that some health care expenditure is included in the HI figures.⁷ (In particular we did not subtract the 608 million in the HI labelled

"hospital care".)

A note should be made of the treatment of future costs. Since our aim here is to calculate payroll taxes for one specific year (1979), there is a problem with events that give rise to expenditures during more than one year. This can be dealt with in two different ways. Either the cost for a branch of industry in 1979 can be made a function of past performance, or the 1979 expenditure can include the present value of future costs. Depending on the available data, both methods have been used.⁸

The actual expenditure in 1979 is presented in Table A2.1 (p. 290). As can be seen, more than 80 % relates to the expenditure not caused by occupational injuries. This creates a disadvantage, for reasons that will be discussed in the next section.

A special problem also arises because of the fact that during the first 90 days after an occupational injury, the insured receives sickness cash benefits from the HI (instead of the WII). During this period the two insurances are coordinated. As will be explained in the next section, it is preferable to treat expenditures related to occupational injuries separately whenever possible. Therefore we have calculated the amount of expenditure from the HI that is attributable to occupational injuries.⁹ (This is item (2) in Table A2.1).

3. Distribution of Expenditures on Branches of Business/Industry

The different types of expenditure were then distributed between 54 branches - this being the most disaggregated level permitted by the data. The principles for this distribution are presented in the column at the far right of Table A2.1. The reasons for choosing the different principles do not require any further comment.

One serious drawback with our material must be reported. It was only for that part of expenditure related to occupational injuries that we were able to distribute expenditures between 54 different branches. The data on the "usual sick-days" is available only at a much more

aggregated level. For this part of the expenditure, the economy could only be divided into 9 branches.¹⁰ To reach the disaggregated level (54 branches), we subsequently attributed to each "sub-branch" the expenditure/wage ratio of the more aggregated branch in question.

Since the latter expenditure is much larger, it determines the relative position of different activities to a high degree. This is easily seen from Tables A2.2-3 (pp. 292-293).

There is one other problem with this part of our data, which is however far less serious. This is the fact that the samples on which the data is based only include persons who are absent from work for a whole week - i.e. what is called "long term absence". On the other hand, a distribution of expenditures using only this data cannot be far off the mark. Empirical results (Eriksen, 1980; Frånvaron i arbetet) indicate that 80-90 % of the total number of sick-days is a result of "long term absence".

4. Results

The results are presented in Tables A2.2-4 (pp. 292-294). In Table A2.2 we only include expenditures for the Social Insurance system related to occupational injuries. The table contains estimates of the payroll tax necessary in each branch to pay for these payments from the WII and the HI. We see that these range from 0.05 % (financial institutions and insurance) to 2.73 % (iron ore mining).

Other payments from the HI that might be related to variations in the WE are added to the above expenditures. The result is shown in Table A2.3. Payroll taxes now range from 5.55 % (financial institutions and insurance) to 15.26 % (restaurants and hotels). The first payroll tax-column indicates these total figures while the second shows what has been added compared to Table A2.2. It is immediately obvious that the addition of other HI expenditures determines the relative position of groups of activities.

Finally, in Table A2.4 we have also added the health care expenditures discussed above. The range has now become 6.5 % to 17.8 %, with the same activities as extreme values as in the previous case.

Notes to Appendix 2

1. Though this insurance also covers commuting accidents, all data used in connection with occupational injuries refers solely to occupational accidents and diseases (unless otherwise stated).

2. We assume that HI expenditures that do not vary with the WE are uniformly distributed between different activities.

3. N.b. the HI only paid for 39% of the publicly financed welfare services related to sickness.

4. Three conflicting tendencies (at least) are operational here. First, production loss is greater than sickness cash benefits. This gives us, ceteris paribus, 1979 levels of expenditures that are too low. Secondly, the cost of health care per case has increased (Spek, 1980) which gives the same tendency. On the other hand (thirdly), not only sickness cash benefits but also some health care is included in the HI and WII figures. This counteracts the first two effects. As mentioned in the text, this also leads to double counting when we add health care expenditures to the HI and WII expenditures.

5. Obtained in conversation with Ulf Persson, The Swedish Institute for Health Economics.

6. The estimated health care expenditure for occupational injuries was subtracted from the original figure.

7. N.b. that a considerable part of the health care paid for by counties and municipalities is not reimbursed from the HI.

The same kind of double counting is present in health care expenditure related to occupational injuries. Here, however, the costs for drugs have been excluded.

8. The former for items (4) and (6), the latter for item (8) in Table A2.1.

9. This calculation is based on the following assumptions:

- 1) 90% of the occupational injuries only result in payments from the HI.
- 2) Those occupational injuries that only result in payments from the HI on average give rise to half as many days of sickness cash benefits as the other occupational injuries.
- 3) The average expenditure per sick day from the HI is the same for cases of occupational injury as for other cases.

Assumption 1) is based on data in Occupational injuries 1975 and Occupational injuries 1976 - June 1977.

10. Roughly corresponding to the 1-digit level of ISIC, namely ISIC:
1; 2,3,4 except 38; 38; 5; 61,62; 63; 7; 8; 9.

Table A2.1: Expenditure included in the data (1979 figures)

Type of expenditure		Expenditure in SEK ^a (mill., 1979 prices)	Principles of distribution between branches
Health Insurance		20 471	
of which:			
(1)	expenditure related to days of sickness cash benefits, except item (2)	19 877	proportion of working days lost due to illness, adjusted for average length of working week in the branch
(2)	expenditure related to occupational injuries	594	proportion of working days lost due to occupational injuries ^b
Work Injury Insurance		959 ^c	
of which:			
(3)	sickness cash benefits, medical care, etc.	308	see item (2)
(4)	life annuities and one-time payments to survivors	529	proportion of number of percent of disablement, average for the period 1969-1978
(5)	burial subsidies and one-time payments to survivors	2	proportion of fatal injuries
(6)	life annuities to survivors	119	proportion of fatal injuries, average for the period 1970-1979
Health care: Occupational injuries		570 ^d	
of which:			
(7)	expenditure incurred in 1979	354 ^e	see item (2)
(8)	present value of future expenditure	216	proportion of number of per cent of disablement
(9)	Health Care: Days of sickness cash benefits ^g	3 119 ^f	see item (1)
		+	
		25 119	

Table A2.1: Cont.Notes:

- a. Apart from the cost of health care due to occupational injuries, we have not attempted to reduce these costs by the amount stemming from injuries occurring on the way to or from work (there being no good criteria upon which to base this adjustment). If these injuries cause expenditures in the same proportion to wages in all branches, this does not introduce any bias to our estimates.
- b. The adjustment for length of working week was only possible at the aggregated level used for item (1).
- c. Note that this figure includes administrative expenses of 31 million SEK.
- d. Expenditures due to injuries occurring on the way to and from work excluded.
- e. Net of costs for drugs in out-patient care.
- f. Based on the cost of hospital treatment only, cf. pp. 285-286.
- g. Net of item (7).

Sources: For the Work Injury Insurance: Försäkringstekniska bokslut 1979 för Arbetsskadeförsäkringsfonden mm, "The Cost and Financing of the Social Welfare Services in 1979," and discussion with Ilmar Norman, the National Insurance Board.

For the other items, see the discussions in the text.

Table A2.2: Payments from the Work Injury Insurance and the Health Insurance due to occupational injuries in 1979, as payroll tax by economic activity

Activity (SNI-code)	payroll tax (%)	Activity (SNI-code)	payroll tax (%)
11	2.57	7113	0.58
12	2.23	7114	1.32
13	0.76	7121/2	1.80
2 excl. 23	1.51	7123	2.14
2301	2.73	713	0.25
2302	2.71	711, 719	
311/2, excl.		excl. 7111/4	0.66
3111/2, 3116/8	1.01	72	0.39
3111/2, 3116/8	1.52	81/2	0.05
313/4	1.23	83	0.32
32	1.08	91 excl. 91002	0.18
33 excl. 33111	1.91	91002	0.21
33111	2.26	92	0.60
341	1.32	93 excl. 933/4	0.21
342	0.33	933	0.34
351	1.00	934	0.41
352	0.66	94	0.22
353/4	0.66	95 excl.	
355	1.43	9513, 95191	0.90
356	1.33	9513, 95191	0.60
36	1.89		
371	1.62		
372	1.52		
381	1.59	average	0.72
382	0.78	lowest	0.05
383	0.62	highest	2.73
384 excl. 3841	0.68		
3841	2.07		
385	1.02		
39	0.64		
41	0.92		
42	1.61		
5	1.39		
61/2	0.44		
63	0.77		
7111	1.15		
7112	0.67		

Table A2.3: Payments from the Work Injury Insurance and the Health Insurance that might be related to variations in the work environment (including those in Table A2.2), as payroll tax by economic activity

Activity (SNI-code)	payroll tax (%)	of which not occup. injuries	Activity (SNI-code)	pay roll tax (%)	of which not occup. injuries
11	14.07	11.50 ^a	7113	12.46	11.88
12	13.73	11.50 ^a	7114	13.20	11.88
13	12.26	11.50 ^a	7121/2	13.68	11.88
2 excl. 23	12.34	10.83	7123	14.02	11.88
2301	13.56	10.83	713	12.13	11.88
2302	13.54	10.83	711, 719 excl.	12.54	11.88
311/2 excl.			7111/4		
3111/2,	11.84	10.83	72	12.27	11.88
3116/8			81/2	5.55	5.50
3111/2,	12.35	10.83	83	5.82	5.50
3116/8			91 excl.		
313/4	12.06	10.83	91002	8.15	7.97
32	11.91	10.83			
33 excl.			91002	8.18	7.97
33111	12.74	10.83	92	8.57	7.97
33111	13.09	10.83	93 excl.		
341	12.15	10.83	933/4	8.18	7.97
342	11.16	10.83			
351	11.83	10.83	933	8.31	7.97
352	11.49	10.83	934	8.38	7.97
353/4	11.49	10.83	94	8.19	7.97
355	12.26	10.83	95 excl.		
356	12.16	10.83	9513,	8.87	7.97
36	12.72	10.83	95191		
371	12.45	10.83			
372	12.35	10.83	9513,	8.57	7.97
381	11.96	10.37	95191		
382	11.15	10.37			
383	10.99	10.37			
384 excl.			average	9.97	9.25
3841	11.05	10.37	lowest	5.55	5.50
3841	12.44	10.37	highest	15.26	14.49
385	11.39	10.37			
39	11.47	10.83			
41	11.75	10.83			
42	12.44	10.83			
5	10.32	8.93			
61/2	8.22	7.78			
63	15.26	14.49			
7111	13.03	11.88			
7112	12.55	11.88			

Notes

- a. An adjusted wage figure has been used to take account of the high ratio of self-employed persons to employees.

Table A2.4: Collectively financed expenditures related to variations
in the work environment (including those in Tables
A2.2-3), as payroll tax by economic activity

Activity (SNI-code)	payroll tax (%)	Activity (SNI-code)	payroll tax (%)
11	16.6	7113	14.4
12	16.3	7114	15.5
13	15.1	7121/2	15.9
2 excl. 23	14.4	7123	16.4
2301	16.1	713	14.0
2302	16.0		
311/2 excl.		711, 719	
3111/2, 3116/8	14.0	excl. 7111/4	14.6
		72	14.3
3111/2, 3116/8	14.7	81/2	6.5
313/4	14.3	83	6.8
32	14.2		
33 excl. 33111	15.1	91 excl.	
33111	15.6	91002	9.5
341	14.4		
342	13.0	91002	9.5
351	13.9	92	10.1
352	13.4		
353/4	13.4	93 excl.	
355	14.3	933/4	9.5
356	14.3		
36	14.9	933	9.7
371	14.6	934	9.8
372	14.5	94	9.5
381	14.2		
382	13.1	95 excl.	
383	12.9	9513, 95191	10.4
384 excl. 3841	13.0	9513, 95191	10.0
3841	14.6		
385	13.2		
39	13.4	average	11.7
41	13.7	lowest	6.5
42	14.5	highest	17.8
5	12.3		
61/2	9.6		
63	17.8		
7111	15.2		
7112	14.8		

APPENDIX 3: A DIFFERENT PERSPECTIVE ON THE VALUE OF LIFE

1. Introduction

As frequently noted, occupational safety and health are among the most important features of the WE. Decisions on these aspects are usually in the nature of changes in low probabilities for personal injury.

The question to be addressed in this appendix is how the government should act with respect to these risks. We confine our attention to risk of death.¹ Elsewhere in the study we assume that "... social decisions should take account of individual preferences and attitudes to risk as these exist at the time of the decision." (Jones-Lee, 1982, p. 284.) This tenet provides one principle for the evaluation of social decisions. Indeed, it is the usual one in economic analysis. In contrast, Broome (1978, 1982) has argued that this is unacceptable in relation to risk of death. In that case, the above principle has the implication that "... a 'statistical' life should be valued on different principles from the life of a particular person." (Broome, 1982, p. 214.)

In this appendix we shall discuss these opposing views. I will argue below that there is no clear a priori case for either point of view. Therefore, I will trace the implications of accepting the latter view, in the second half of this appendix. The results are used in section 6.2 above in relation to certain aspects of WE policy.

Of course, many have discussed if statistical lives should or should not be treated as real ones.² However, in my view it is more correct to start with the discussion of how government actions should be based on individual preferences. If they are based on ex ante preferences, then, given our premises, a statistical life should by implication be valued less³ (by the government⁴).

In our analysis, following Möller (1982, 1983) we take as our starting point the rules that should govern individual conduct with respect to risks for other people. I also take the view that these same rules should, ceteris paribus, apply to government decisions.

Before we proceed we should note that our discussion pertains only to Swedish society as it exists today.⁵ I also assume that this society is predominantly non-religious, and that the non-religious majority can (and have an ethical right to) determine government policy.

A religious society, on the other hand, might express quite different values. For example, the utility loss of early death can hardly be independent of our attitude in this respect - if we regard (this) life on earth as "all there is", or if it is just a small (possibly insignificant) part of a larger whole. Likewise, basic differences might arise with respect to other non-religious societies.

2. Some Basic Rules for Individual Behaviour

Möller (1982, 1983) has recently analyzed these policy issues from an ethical point of view, and we will refer to his analysis repeatedly.

Along with a number of moral philosophers, Möller (1982) concludes that human life for ethical reasons should be accorded special value (cf. Möller, 1982, pp. 1-18).⁶ Another possibility would be to base this conclusion on the concept of social contracts. One model of our society is the social contract, entered into by all individuals (including those as yet unborn). It is reasonable to assume that no individual would have agreed to that contract, if it had not stipulated that special value should be attached to human life. Note that adopting a "common sense" approach, it is hardly surprising that human beings attach a special value to human life. However, most of the analysis below is equally valid without a special value being attached to human life. Both cases will therefore be treated simultaneously. We will note those instances when the "special value" argument makes for a difference. When we refer to Möller it should thus be understood that he argues on the basis of a "special value" to be attached to human life. Unless otherwise stated we consider that it is permissible to extend his argument to the other case.

Even if we attach a special value to human life, we could still justify, as Möller (1982, ch. 2) convincingly argues, that as individuals we subject other persons to small risks of death. Basing his discussion on Fried (1970), he begins by noting that it is rational for each individual to take some risks during his/her life. The individual makes a "life plan" which includes a risk budget. The latter indicates which risk of death the other goals in the life plan make it worth taking. In addition, it is beneficial for people to exchange risks. In other words, other persons are allowed to increase your risk of death in order that you are able to do the same to them. If this was not the case, life would be pretty intolerable. For example, you could never drive a car. Note that no open consent is required from the individuals whose risk you increase. (If we take the social contract view, this solution for individual behaviour is of course quite natural.) Obviously, these arguments only apply to low probability cases.

This line of reasoning appears even more convincing when no special value is attached to human life.

Thus, it is established that it is permissible for any one person to "slightly" increase the mortality of groups or individuals. On the other hand, Möller (1982, ch. 3) argues that this is almost the only case where we may act so that our action may directly result in the death of a person. There are differing views as to whether there are any circumstances that make such behaviour acceptable. We need not enter into the details of this discussion. In section 4, we will assume that it is never permissible to act in a way that directly kills somebody else.

3. Rules of Individual Behaviour Applied to Government Actions

It is often assumed in economic analysis that government action is justified if it increases total ex ante utility in society i.e. if the action as valued by the preferences of individuals (with or without distributional weights) is expected to produce more benefits than costs.

The next step usually taken is more controversial. It involves proceeding via the potential Pareto improvement criterion to the use of willingness-to-pay to measure utility changes (usually as a Hicks-Kaldor test of compensating variations). There are some pertinent practical and theoretical problems involved here.⁷ However, these considerations will not to be discussed in the present context.

We will confine our attention to the more basic problem. Namely, are the utility changes to be considered here those that exist ex ante (before the action is taken). This is the usual assumption although it is not self-evident that this principle applies to changes in the risk of death.

If the government acts so that the risk of death is increased for a large group of people, a number of individuals will as a result of this action face early death. Could such an action be justified on the grounds that the risk for each individual is only slightly increased? The government would then be seen as a middleman in the exchange of risk between individuals. Or is it the other way around? Should the government, acting as our agent, treat a "statistical" life on an equal basis to "real" lives. This is the view of Broome (1978, 1982). (His position is in fact even stronger, as we shall see.)

Broome (1982) notes that a government that bases its decisions on the preferences of individuals⁸ can do this in two ways. Remember from Chapter 1 that the outcome of an action is not certain, but depends on which state of the world occurs. When choosing between two actions, the government can as one option use the preferences of individuals over these actions - termed "endostochastic preferences" by Broome. Or, the government can use the individual preferences over the possible outcomes of the actions - "exostochastic preferences". This is precisely the problem described above.

Broome shows that compensation tests based upon endostochastic and exostochastic preferences respectively may give different answers when choosing between two actions. He argues that if the compensation test is to be used, it must therefore be the exostochastic version. If such tests are at all applicable, they must be so for actual outcomes.

Thus Broome explicitly rejects the notion of basing these social decisions on peoples' ex ante preferences for risk reduction. This view has been criticized by Jones-Lee (1982), to whom we now turn.

Jones-Lee (1982) notes correctly in his comment on Broome that the latter does not in fact prove that the endostochastic compensation test should be rejected. (It only follows when the exostochastic test is defined from the outset as superior.) On the other hand, I remain unconvinced by Jones-Lee's argument in support of instead dropping the exostochastic compensation test.

The main argument of Jones-Lee is that the exostochastic compensation test "...will treat as socially indifferent all zero-sum reallocations of financial risk. This is so because under each state of the world gainers could just (and only just) compensate losers [...] The exostochastic compensation test would therefore imply that it is a matter of social indifference whether or not we have, say, property insurance - an obviously absurd implication [...] such insurance exists because people want it to, that is, it satisfies endostochastic preferences..." (Jones-Lee, 1982, p. 284).

I shall endeavour to refute this argument. Note first that nobody has suggested that individuals do not act according to their endostochastic preferences (or that this should be deemed to be unsatisfactory behaviour). The question is if the government should base its decisions on them. Jones-Lee is naturally correct in asserting that reliance on the (simple version of the) exostochastic compensation test does not tell us whether we should prefer the situation with or without property insurance.⁹ However, this does not necessarily mean that we have to be socially indifferent between these options. The compensation test need not (indeed should not) be our only basis for decision-making. We can still take account of individuals' attitudes to risk: their risk aversion and disutility from risky situations. In fact, Broome does not say that we should not do this, only that an endostochastic compensation test is not the right way to do it (cf. Broome, 1982, p. 203). Obviously, we can take account of these attitudes in several ways. One method is to have the decision criterion, that given that our action is not rejected by the exostochastic compensation test, we should adopt it if it decreases the risk for individuals. Alternatively, the latter part could be substituted by an endostochastic compensation test. In these cases we

use the exostochastic compensation test as a necessary but not sufficient condition.

Also, Broome (1982) in his model assumes that "Each outcome is a complete future for the world [...] Anything of importance that we would normally think of as a feature of the action must be written into its outcomes [...] any worry, excitement or other effect that may arise from the uncertainty itself." (Broome, 1982, p. 201.) If we accept this model - and in this context I think that we should - the problem is of course solved. Then the outcomes without property insurance should be specified as "payoff so and so, the individual not having been insured," and vice versa. The government will then choose the action of having property insurance. This would hold, even when total wealth is reduced in every state of the world, because of transaction costs associated with the property insurance. (In this case a "simplistic" exostochastic compensation test would positively reject the property insurance.)

Having finished with the Broome vs. Jones-Lee debate, we next consider Möller's (1983) argument for basing social decisions on the risk changes for individuals, rather than on statistical lives. He notes that small risks when dealt with at the social level become highly concrete deaths. However, he argues that the acceptance of a new ethical dimension in the aggregation of small risks has some strange consequences.

First, whether a risk is acceptable or not depends on the level at which we deal with social decision-making. A risk that is acceptable for a community council (small risk population) may then be unacceptable for the government (large risk population).¹⁰

Secondly, we would have trouble with the definition and the delimitation of risks. The acceptability of a risk will depend on our definition.

To begin with the second argument, I fail to see that this is a conceptual problem. For every possible action (or non-action) of a public agency the effects on the mortality of different groups may be specified. If we want to base our decisions on individual preferences we would have to investigate carefully how individuals consider their

risk situation. But if the population at risk is so large that there is probably a life at stake, then this is all that we require to know. As we shall see it is another matter that this aspect of no clear limits for the risk on which we are deciding has definite implications for our argument.

The first consequence pointed out by Möller is rather peculiar. This I willingly admit. However, I do hold that this is no stranger than the alternative. This, remember, amounts to the statement that while it is absolutely forbidden to kill a specific person, it is quite alright for the government to act so that somebody will die (provided only that we do not know beforehand who it is we are killing). I contend that this may well be classified as equivalent to directly causing the death of a specific person.

Before closing this section, there is one point that should be clarified. As noted by Broome (1982), when dealing with these issues it is important not to be confused by the value of randomness. It may be thought that increasing mortality is acceptable because the extra deaths incurred are randomly distributed among the population. However, this is not the case. If it was, it would be acceptable to kill someone on the basis of a lottery decision if the gains were sufficiently large (e.g. saving other people). Such behaviour is condemned by Möller, and I suspect that everybody would agree. This shows that it is not randomness in itself which might make it permissible to kill a statistical person.

What I have tried to show in the above pages is that we have two alternatives for evaluating social decisions that influence the risk of death, and that neither can be rejected a priori. In particular, I have argued that "statistical" lives may well have to be considered on an equal basis to "real" ones.

The opposite view has only been given brief attention. This is because it is presumably well-known, and probably more intuitively comprehensible (at least for economists). It states that the government should base its decisions on the preferences of the citizens at the time of the decision. In dealing with mortality, the government will therefore show the same consideration as an individual would or should.

Since the exostochastic version cannot be rejected, it seems logical to trace its consequences. (The rest of this study is based on the other view.) This is what we will do in the rest of this appendix.

We should also note that if public policy is ever to be based on this view, merit wants are implied. This is so because by definition individuals otherwise favour an endostochastic valuation. (Or do most politicians once elected go through an ethical metamorphosis?)

Having concluded that the exostochastic preferences principle merits consideration, the next step is to investigate how this principle affects policy-making. Using exostochastic preferences implies that we are concerned with ex post rather than ex ante optimality. Already this very general proposition has some implications for public policy principles, as demonstrated in section 6.2. However, it is also desirable to be somewhat more specific. This is the object of the next section.

4. Policy Implications of Treating "Statistical" Lives as "Real" Ones

Henceforth, to increase (decrease) the risk of death for sufficiently large groups is for the government equivalent to directly killing (saving) someone.

To derive more specific (though still theoretical) policy implications, a number of additional assumptions will be necessary. In this context, quite a few intricate ethical problems will be touched upon. It is not our purpose to contribute to the discussion on these issues. We merely seek to derive a reasonable well-founded basis for applying the "exostochastic preferences" way of making government decisions. On many points we will therefore be very brief. A lengthier discussion can for example be found in Möller (1982, 1983).

Increasing the Risk of Death

We begin by discussing the case of increased mortality. Is it ever permissible to directly kill someone? As noted above, different philosophers have different views on this question. For the sake of simplicity, we assume that an action that directly leads to the death of an innocent¹¹ person is never justifiable.¹² The result for WE policy would hardly change if this assumption was slightly relaxed. (For example, so that "extreme values" may be a sufficient justification. This standpoint is taken by Möller (1982, p. 49).)

However, there is one exception that must be made. This is the case where the person killed by the action would have decided in favour of it even when this outcome was known to him. To explain why this is not a purely theoretical case we emphasize two aspects of such decisions.

First, changing the mortality not only changes the time of death of a person, but also the way of death. Secondly, what is lost is not "life", but years of life. The way of death can become better or worse. It seems likely that there could be cases where an improvement in the way of death could be worth the loss of some time alive, and vice versa. Likewise, improved economic conditions could probably be worth some such loss. (Cp. the years-to-life vs. life-to-years debate.)

Now, there can be government actions that only increase the risk of death by a small amount or for a small population. This kind of action may be justified if the gain is large enough. For this to be the case, the aggregate risk - that is, the risk for the "statistical" person - must be so small that it can be justified on the grounds of voluntary exchange of risks.

This, incidentally, is my way of solving the decision problem posed by Broome. With his approach, every increase in mortality means that there is at least one more state of the world where someone is dead, which cannot be compensated. One realizes that the solution depends on concentrating on the statistical risk rather than states of the world.

Decreasing the Risk of Death

Now we can turn to mortality decreasing (life-saving) actions. This is of special interest to us, since much of WE regulation is of this nature.

First we must consider if they represent a different issue at all. Unless we place a priori restrictions on government actions there is no logical difference. For all possible actions, the government has the option of action and non-action. There is no difference between choosing to kill and not-choosing not to kill. The question then is to what extent this applies to value statements.

Implicitly, we have already assumed a difference. From the standpoint that killing is never acceptable, it follows that it is not permissible to kill one person in order to save others. If there was no difference, that choice would be indeterminate. However, we assume that no individual needs to sacrifice his/her life to save another.

That could still leave us in a situation where everything except human life should be sacrificed to save human life.¹³ We could never then differentiate between projects that decrease mortality rates. (While I argued that this was correct for projects that increased mortality, it does pose a problem in the opposite case.)

However, there does seem to be a difference from an ethical point of view. For a moment we turn back to the level of individual behaviour. Möller (1982, p. 38) argues with Fried (1978) that there is such a difference inter alia because every human being also has a right to fulfil his/her life plan. (See Möller, 1982, pp. 34-38 for a more complete discussion.) One is therefore not obliged to give up everything to save others. One could add that this makes perfect sense with the social contract approach. Also, it would appear consistent with the prevailing intuitive ethical opinion in our society.

Given that as individuals we need not sacrifice everything to increase the life time of others, what actions should the government take to increase the life time of persons or groups of persons?

I have deliberately posed the question in this form. As it stands, it includes both saving persons that face a high risk of death, and decreasing the risk of death for people that face a low probability.

There are two issues at stake here: "Does there enter an extra dimension when a person is in immediate peril?" and "Which category do our 'statistical' lives fall into?"

The second question is immediately answered by our earlier discussion. The "statistical" persons are in as acute distress as any "real" person could be. The heart of the matter seem to be the probability of death. This can be just as high for a "statistical" fatality in manufacturing industry, for example, as for a trapped miner or seamen on a boat in distress at sea. As noted in Linnerooth (1982) "statistical" victims will in many cases be perfectly identifiable at a later point in time. Therefore, it seems doubtful to appeal to special human relations with "real" persons as opposed to "statistical" ones.¹⁴ (Otherwise this could perhaps have provided a rationale for particular interest in the former.)

The other question is "Should a greater effort be made to save people in acute danger?" Möller thinks that we should (Möller, 1982, pp. 6-7). He argues that this will place us in a new existential situation, that introduces ethical obligations of a particular kind.¹⁵ If we accept that a special value is accorded to human life, then this seems indeed to be a sensible application of this tenet.

Even if we do not accept the "special value" argument there are other arguments in favour of extra efforts to save those in immediate peril. First, while small probabilities of death can be justified in terms of voluntary acceptance and/or exchange of risks, this does not hold for high probabilities.

Secondly, the approach to base values on individual preferences can yield this result. This follows from individuals' increasing willingness-to-pay for risk reductions as the level of risk increases.¹⁶ Thirdly, risk equity could provide an argument for giving priority to high risk cases.

I will proceed under the assumption that the above distinction is relevant. However, as we shall see, the adoption of this principle has only a minor effect on resource allocation within the public sector. In addition, it means that we should sacrifice more to save others than if we did not accept it.

It must of course be realized that this position entails a consequence that some would consider awkward. Given scarce resources, it implies sacrificing more lives than we save (at the margin) in terms of mathematical expectations. Thus, to take this position implies rejecting the efficiency argument that we should maximize the expected number of lives saved.

However, from the social point of view, it seems reasonable to say that no low risks exist that would allow us to save high-risk cases. If one tries to argue that there is, one is forced to make arbitrary limitations in the choices open to government. A potential government decision can include as many kinds of risk as one likes, for an indefinite period of time. Thus, any low risk can be transformed to a high one by increasing the time perspective and/or by making it part of a more all-inclusive decision on risk.

Hence the obligations that accrue to the individual when a fellow human being is in immediate peril accrue to the government for all risks of the population (in the case of risk decreasing activities). This means that we can reintroduce an efficient (lives-saved maximizing) allocation of resources. However, this only holds for risks that are equal in a number of aspects. We shall now discuss these aspects.

What the government ought to do to decrease the risks people are facing will probably depend on a number of factors. Note that actual policy must always be concerned with reducing the risk of death faced by individuals and groups. This is the way to save "statistical" lives.

Möller (1983, section 5.4) argues that we should take account of the extent to which the risk is voluntary. Though he discusses only cases where there are low probabilities, I contend that this principle should also apply to high-risk cases. The general principle is that it is more acceptable that people bear voluntary risks. This is intuitively appealing. In relation to the WE, Chelius (1977, pp. 2-3) argues that we are less willing to accept risks at work, inter alia because they are less voluntary. We do not say more about this aspect here, since it was extensively discussed in section 6.2.

Should one differentiate between man-induced risks and those that enter every life of a human being? I cannot see that we should. Rather it seems appropriate to be equally concerned for the victims of infectious diseases as for the victims of cancer induced by working conditions (in a case where they are equally dangerous and the both are totally non-voluntary).

The argument is that the case for government intervention is stronger, the greater the non-voluntary nature of the risk. Apart from the resources used there is an additional negative effect from intervention namely the fact that it impinges on the autonomy of the individual. (Cf. Möller, 1983, pp. 13-19.) It interferes with the life plan.¹⁷

We now turn to the risk equity aspect. Given the implicitly agreed upon exchange of risk, Möller (1983, p. 9) argues that (man-induced) non-voluntary risks should not be too unequally distributed. In my opinion it makes good sense to extend the equity argument to all non-voluntary risks. In other words, groups that face a high level of (non-voluntary) risks should have priority in risk reduction.¹⁸

Of course, it is perfectly possible that there are non-voluntary risks that the persons in question do not want removed (for example because they find their share of the costs excessive). Then we should not interfere; the case is analogous to voluntary risks. Other factors to consider is the manner and time of death that is implied by the risk(s). Since this is obvious I will not dwell on it.

Summary of Policy Implications

We are now ready to summarize the general prescriptions for government actions that have been discussed in this section.

First, it is generally not permissible to directly increase the risk of death by so much for such a large group of people that it leads to the death of a "statistical" person. This holds even if we thereby could have saved a greater number of persons from death.

On the other hand, if the "aggregate risk" is small enough the action may be permitted.

In the case of life-saving, we have argued that we need not sacrifice everything to save others. But the government when deciding on risks faces the same moral obligations as an individual seeing another in immediate peril. Note that there is an asymmetry here between life-taking and life-saving. In the latter case, it is not meaningful to talk about small probabilities. It is always possible to redefine the situation so that a life is at stake. Such redefinitions are not relevant in the former case.

It follows that life-saving resources should in general be efficiently distributed. Any deviations must be motivated by differences in the situation. The mitigating factors are the following ones. The more non-voluntary the risk, the more intervention is called for. In addition, the manner and timing of death should be considered. Finally, considerations of risk equity could suggest that those facing high non-voluntary risks should receive priority.

Notes to Appendix 3

1. Other health and safety risks may pose problems similar to those treated here. Since our analysis is mainly indicative in nature, we are satisfied with using risk of death as an example.

2. See Möller (1983) for some references.

3. It is naturally possible to accord "real" lives so little value that the "statistical" one is higher valued even with the ex ante approach. This is hardly relevant, however. See also the discussion below on according a special incommensurable value to human life.

4. This is not to say that an individual may treat a statistical life differently from a real one. However, this situation will rarely occur, as will be clear from the following analysis.

5. Thus, in contrast to Möller (1982), I do not find it likely that we can find some basic premises for the value of human life that holds among all possible societies. Cf. the discussion below.

6. Möller uses the argument of Nozick (1981) that the human properties of "being an I" and being a "value seeker" give special value to man.

For our purposes, we would prefer a norm that can encompass such borderline cases as those human beings that lack one or both of these properties. Other objections apart, it is therefore not without difficulties to use the approach of Möller.

However, this is not the place to dwell on these points. Remember also that there are other ways to reach the same principal conclusion.

7. Cf. for example Lindeney (1984), Linnerooth (1982), or Nash, Pearce and Stanley (1975).

8. We assume here that the government in a democratic country should do this.

9. Note that it must be a test of potential compensation for this statement to be meaningful. If we deal with actual compensation the indifference must be correct (equity issues apart), since we have then returned to the status quo ante the financial reallocation.

10. A firm usually has a "small" population which makes it unlikely that employers individually ought to take account of "statistical" lives.

11. Möller (1982, pp. 61-62) makes a useful distinction between innocent and non-innocent persons. He argues correctly that non-innocent persons can hardly expect the same treatment as others. Non-innocent persons are those that break the rules of society.

12. There is one class of actions that at the same time increases one kind of death risk and decreases another kind, for the same group of people. In that case one should obviously look at how the total risk of death is affected by the action.

13. We ignore cases where increasing the number of years of life is seen as a decrease in utility by the individual, in the way envisaged above.

14. The timing should not be accorded great importance here. Of course it is, ceteris paribus, better that a death occurs later in time. If we had an absolute choice between killing someone today or tomorrow, it is better to do it tomorrow (and vice versa for life-saving). However, this argument cannot change the fundamental nature of a situation. In particular, it does not make a "statistical" life qualitatively different from a "real" one.

15. At the same time, Möller (1982, pp. 6-7) argues that this holds only for "real" lives, not for "statistical" ones. As should be clear from my discussion, I do not agree.

16. Cf. for example Linnerooth (1982) pp. 231-35 for a derivation of this result.

17. Government provision of risk reductions could be justified in some cases by the usual efficiency arguments. For example, in those cases where only technical problems had prevented individuals from obtaining risk reductions. Thus, indivisibilities and free riding provides another rationale for certain rescue facilities. However this is of no consequence for the discussion here.

18. In contrast to Broome (1982, p. 24) I can see an intrinsic merit in equal distribution of expected utilities in this sense.

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